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1915

BUREAU OF PUBLIC WORKS

DEPARTMENT OF COMMERCE AND POLICE
PHILIPPINE ISLANDS

Quarterly Bulletin

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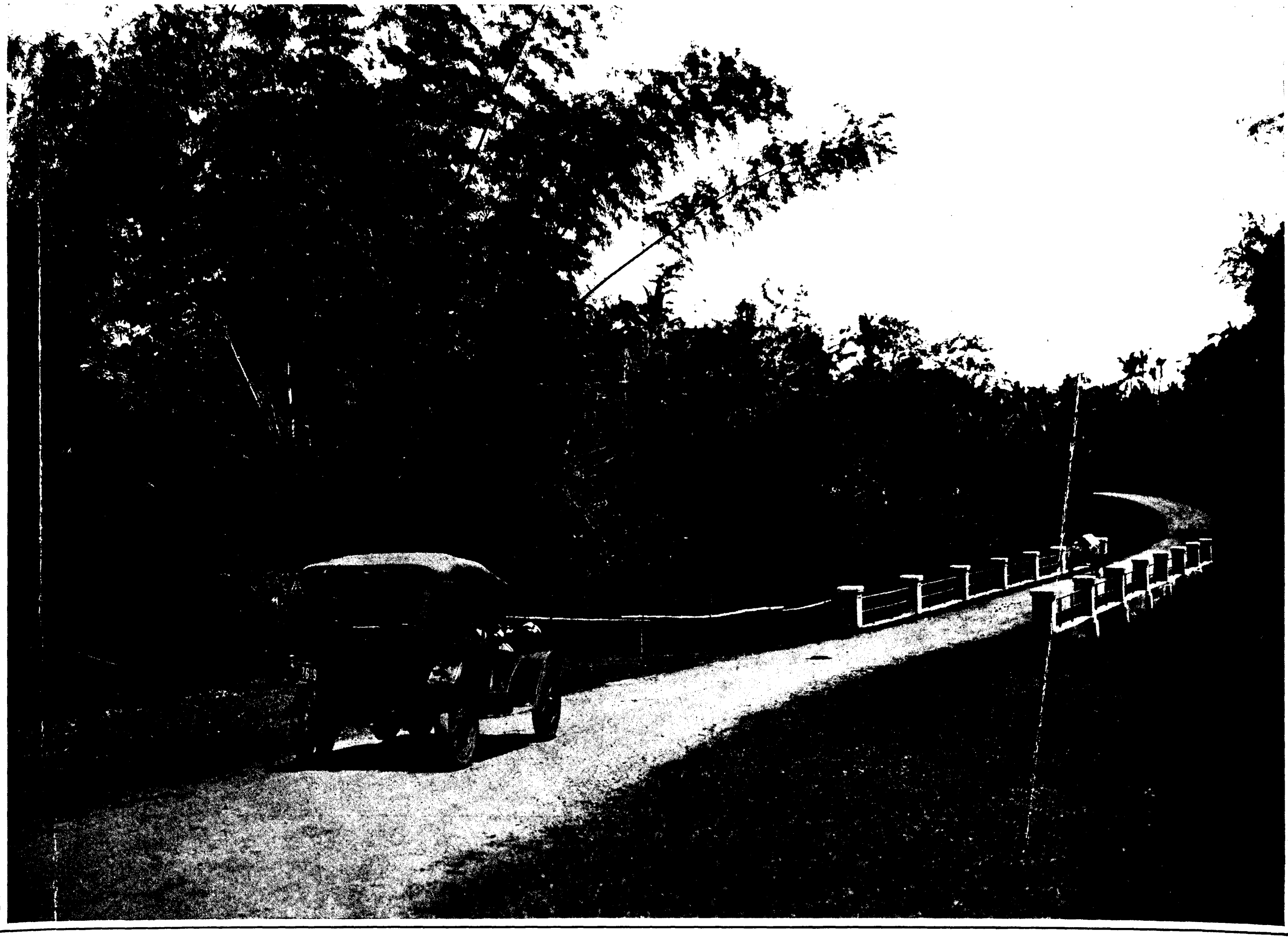

Candelaria Bridge on kilometer 22, Candelaria–Tiaong Road, Tayabas Province.

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QUARTERLY BULLETIN

BUREAU OF PUBLIC WORKS
MANILA, P. I.

ISSUED QUARTERLY BY
THE CONSTRUCTING DIVISION, UNDER THE DIRECTION OF
THE DIRECTOR OF PUBLIC WORKS

C. A. TANSILL, COMPILER OF STATISTICS

The objects of the QUARTERLY BULLETIN are:

1. To show each engineer and employee of the Bureau of Public Works the work of the Bureau as a unit.
2. To show him that his work is a unit part of the whole.
3. To make clear to every provincial and municipal official and to the people the work being done by the Bureau.
4. To make the work of the Bureau of personal interest to all.

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ENGINEERING LEXICOLOGY.

Sometime since, the question of properly designating the mechanical analysis of a granular substance, involving the determination of the percentage of grains of various specified sizes, came up. A number of terms, all of which express the idea with more or less accuracy, were proposed, these being "granular," granometric," "granulometric," and "granular-metric" analysis. Of the four but one, "granular," was to be encountered in any of the available dictionaries and none of its various definitions was satisfactory to all parties concerned. There existed certain precedents for the coinage of the three remaining words in such terms as "volumetric," "gravimetric," and the like. The question was thereupon submitted to the Standard Reference Bureau of the Funk & Wagnalls Company and the Century Company, from whom these replies were received:

NEW YORK, *April 22, 1915.*

DEAR SIR: Replying to your inquiry relative to the coining of a word or phrase to describe the process of mechanically analyzing a granular material, such as sand, we have considered all of the proposed phrases you give, and, so far as etymology and the combination of elements are concerned, find them all correctly formed. Our feeling in the matter as to the relative merits of the four may be best expressed by numbering them, No. 1 representing our first choice, and so on:

1. Granulometric analysis.
2. Granometric analysis.
3. Granular analysis.
4. Granular-metric analysis.

The last-numbered phrase is a trifle rough—that is, the combination of *granular* and *metric* jars on the ear and is obviously inferior to the smoother form *granulometric*, which seems to express most fittingly just what you are aiming to describe.

It must be distinctly remembered that the function of a dictionary and of its editors is not to coin words, but to record their usage, and that we do not in any way undertake to devise or to lend our authority to the formation of any new words. These must be evolved and used by some one of reasonable authority in the art or profession concerned, and when we find them so used and recognized, we shall be glad to record them.

Yours very truly,

FUNK & WAGNALLS COMPANY.

APRIL 11, 1915.

DEAR SIR: We are in receipt of your favor of January 30, asking our opinion as to the best designation for the process of analyzing granular material with reference to the percentage by weight of each of a series of designated sizes of grains. In reply, *granular analysis* is a good designation, giving the essential idea, but laying no stress on the "measuring" idea, which it may or may not be important to bring out. The other three terms all lay stress on this idea, and are, therefore, somewhat more definite, but also more cumbersome, in our opinion. Of these, all might be said to be correct, the first, *granular-metric*, being full and definite but rather clumsy; the second, *granulometric*, a shorter equivalent of the first; and the third, *grano-metric*, equally proper. Of the three, we rather incline toward *granulometric*, which we think would be better written as one word without the hyphen.

Yours very truly,

THE CENTURY DICTIONARY EDITORIAL DEPARTMENT.

Usage has not crystallized into a generally accepted term to express the desired idea, but from the etymologist's point of view "granulometric" represents correct practice in word coinage, and fully expresses the engineering idea involved. The following engineering phrase is proposed:

"*Granulometric analysis*, the mechanical analysis of a granular substance, with especial reference to the determination of the proportion of grains of various sizes."

C. E. Gordon

FIRST-CLASS ROAD DESIGNATION, JANUARY 1 TO JUNE 30, 1915.

Province.	Kilometers.
1. Pangasinan	210.9
2. Cebu	170.0
3. Iloilo	162.3
4. Ilocos Sur	141.3
5. Albay	134.8
6. Tayabas	133.0
7. Capiz	128.8
8. Occidental Negros	128.2
9. Ambos Camarines	120.1
10. Laguna	120.0
11. Leyte	113.0
12. Rizal	110.8
13. Batangas	106.4
14. Bulacan	91.1
15. Sorsogon	80.9
16. Nueva Ecija	80.5
17. Pampanga	70.6
18. Cavite	68.2
19. Bohol	62.0
20. La Union	59.9
21. Ilocos Norte	59.5
22. Samar	55.7
23. Antique	54.0
24. Isabela	49.8
25. Oriental Negros	44.8
26. Misamis	42.6
27. Tarlac	37.4
28. Cagayan	30.0
29. Bataan	21.2
30. Surigao	14.7
31. Zambales	1.9
Total	2,704.4

BURKHARDT VON SCHMELING.

A BUILDER IN THE PHILIPPINES.

1879—Born in Germany—Died on the field of battle for Germany—1915.

This tribute to him—my friend—who fell on the blood-soaked fields of Europe, is to those and for those, his associates, who loved him, and to the people of the Philippines, amongst whom he wrought for better things.

No fulsome meed of praise is this—for that, he who has gone before would not wish—but a tangible token of regard for a man. Essentially a man's man, Burkhardt von Schmeling played wholeheartedly, worked with all his might, and when the supreme test came, offered up his life for the land of his fathers. Such an one is fit to meet face to face his fellows, and enter upon the solution of that problem, which we all must solve, unafraid.

Burkhardt von Schmeling entered the service of the Bureau of Public Works in 1909. The results of his services may be seen in many places throughout the Philippine Islands, and his work was good.

In February, 1914, he sailed from Manila for San Francisco on a well-earned vacation, which he expected to spend in the United States and Europe. Shortly after his arrival in the United States he married, and continued on his vacation, now a honeymoon, for Europe. Preparing to sail for the Philippines with his bride and again take up his work here with new courage and a bright future, the war cloud burst. He immediately returned to Germany, resigned his position in the Bureau of Public Works, and offered his services to the German Emperor. He was commissioned and assigned to duty on the western battle line where he remained until, as a captain, he was killed—killed in an heroic effort to save a wounded comrade lying on a bullet-swept battle plain. He had received the iron cross, second class, on his birthday in February and had been recommended for the first class shortly before his death.

Burkhardt von Schmeling was greatly desirous that his offer of service to the land of his fathers be approved by his American friends, and in his first letter to me after joining the German army this desire was feelingly expressed.

In my reply which I hope he received, and copies of which I believe his wife and mother did receive, I said:

> You know me well enough to know that I believe that in times of great national peril, such as now confronts the German Empire and her people, the question of right or wrong, of justice or justification, should be relegated to the limbo of oblivion and the slogan "my country right or wrong" be the only principle which should control true men. Among all Americans whom I know the course which you have pursued in offering your services to the German Emperor is approved, and, as for myself, it was with the greatest pleasure that I heard you had returned and that your services had been accepted. In the great struggle, in which all must admit the integrity of the German Empire and the unity of the German people are at stake, may you so conduct yourself that, live or die, your actions will be remembered by your countrymen and your family with pride. Life, merely as life, is not the most precious thing to the intelligent man. An honorable death is more satisfactory and will result in greater good to one's country and family than a cowardly, scurrilous life. So, whatever may befall you, do those things that will make one proud to have known you.

Who doubts that he died, as he lived, a manly man, a true friend, a knightly gentleman? I am proud to have known him.

The earth in Europe will be hallowed by the lifeblood of her noblest children, but no earth will be more hallowed than the earth that embraces the mortal remains of Burkhardt von Schmeling.

In valediction I speak the words which speeded many of our casual partings:

"Adios, Von, be good."

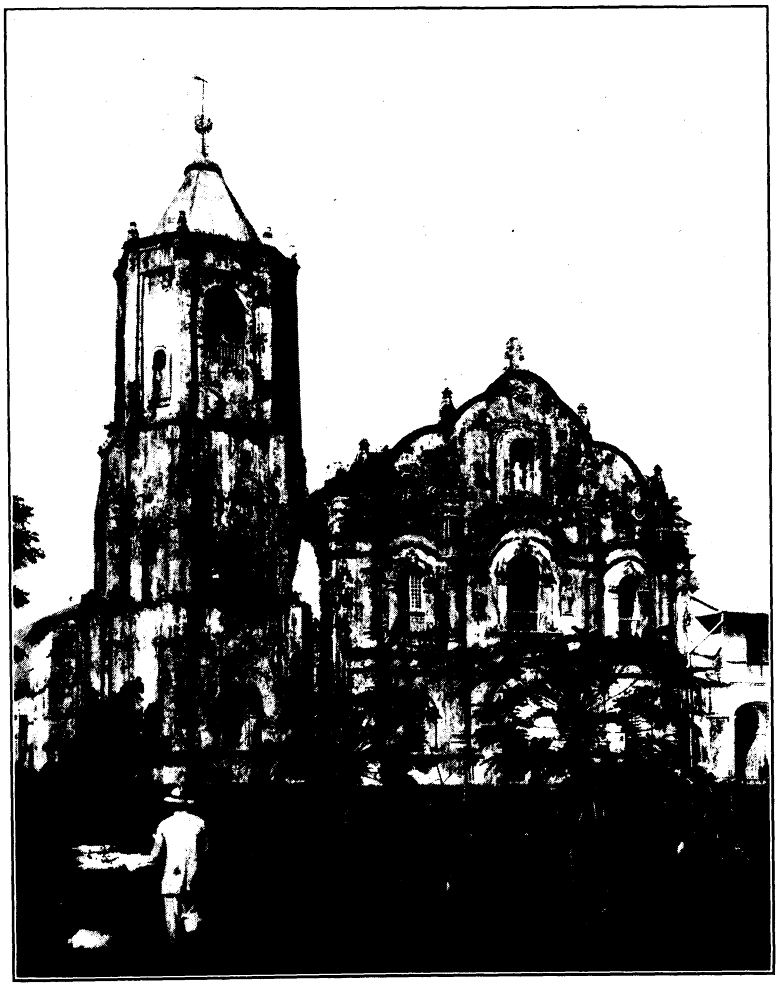
A Hausill

TAYABAS PROVINCE FROM AN ENGINEERING POINT OF VIEW.

By A. T. SYLVESTER, District Engineer.

[See title-page for view of Candelaria Bridge.]

The written history of Tayabas Province begins with the advent of the Spanish explorer, Juan Salcedo, who, in 1571, explored the central portion of the present province. In 1572 he circled the north coast of Luzon and journeyed as far south as the present town of Infanta. About 1600 the towns on the Bondoc Peninsula were united to form the Province of Kalilayan, with its capital located at the town of the same name (now known as Unisan). Religion and education were introduced at an early date by the Franciscan friars. The establishment of the towns of Lucban, Mauban, Sampaloc, and Tayabas followed. By 1740 the towns of Atimonan, Candelaria, Gumaca, Lopez, Sariaya, and Tiaong were founded, all being included in the Province of Kalilayan.



Lucban Church, Tayabas Province.

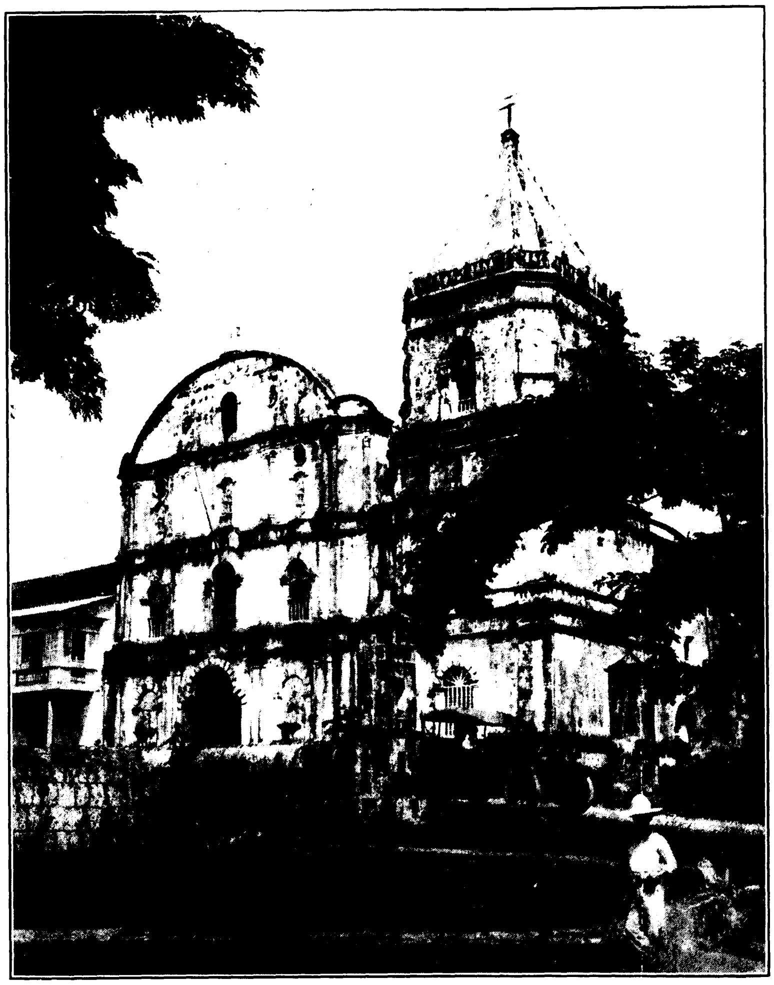
As a result of piratical Moro raids, the capital of the province was moved to Tayabas late in the eighteenth century. Surrounded as the new capital was by thickets of "bayabas," or guava bushes, it became known as the place "located among the "bayabas," which was shortened by usage to "Tayabas" and finally became the name of the province. In 1901, after the assumption of American sovereignty, the capital was transferred from Tayabas to Lucena. In 1902 the former Provinces of Principe and Infanta, together with the Island of Polillo, were added to Tayabas Province and in the same year Marinduque was annexed as a subprovince.

Geographically, Tayabas Province occupies the lions' share of the Island of Luzon and extends from the thirteenth to seventeenth parallels of north latitude, approximately, and lies between the one hundred twenty-first and one hundred twenty-third meridians of east longitude. It has an area of approximately 6,000 square miles (the largest province in the Islands). Mount Banahao, an extinct volcano, reaches an elevation of 7,000 feet and is the green-clad sentinel over miles of mountains, valleys, and plains where over 365 million coconuts are raised each year.

Marinduque, the Polillo Group, and Alabat are the principal islands included within the political boundaries of Tayabas. Of these, Marinduque is the most important and is administered as a subprovince.

ROADS.

The isolation of the 32 municipalities scattered over this great province renders the operations of government, even with the aid of the telephone and telegraph, necessarily difficult and costly and makes the construction program for public works an important study. The adoption of a proposed road system, which will ultimately provide a through route to Manila, with feeder roads to the railroad and main trunk highway, seems the only justified procedure, considering Marinduque and the other islands as separate problems. The towns lying far up the Pacific coast—Infanta, Baler, and Casiguran and those scattered along the eastern coast of the Bondoc Peninsula—are so small and isolated that water transportation suffices.



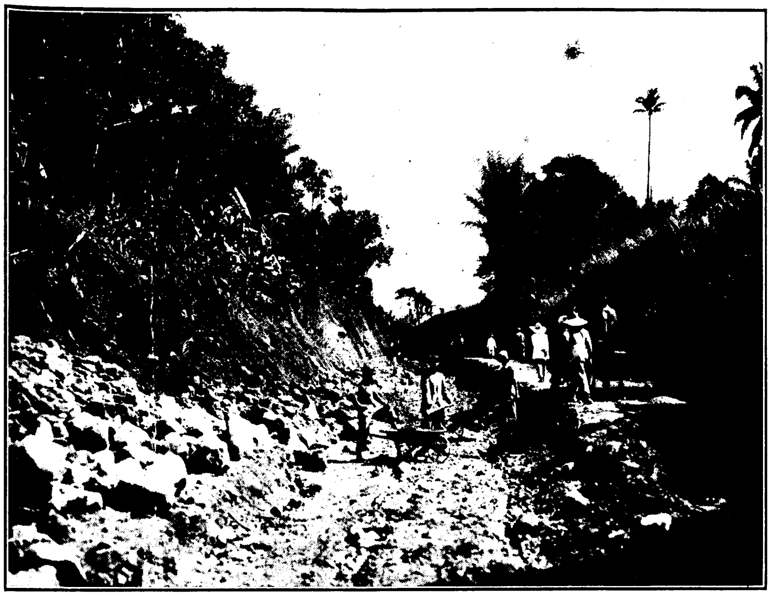
Tayabas Church at Tayabas, Tayabas Province.

In the days of the Spanish régime, there were roads leading from the old capital, Tayabas, to the adjoining towns, and trails across the mountains to Majayjay in Laguna Province, from Lucban to Mauban, and from Pagbilao to Atimonan and then south to Gumaca and Lopez. The road from Tayabas was paved with bowlders and was much traveled, Pagbilao being the port for the capital. The road from Tayabas to Sariaya was also paved with stones, but beyond Sariaya there was only a dirt road. The Tayabas–Lucban Road was paved and was the main route to Manila.

In the lowlands these roads and trails were wide and well graded, but in the mountain sections the cuts were narrow and grades heavy, which is what one would expect where labor was scarce.

The Bondoc Peninsula, then as now, must have depended upon water transportation, for its rugged hills, its many streams, and untamed forest growths have proved a serious obstacle to road construction even until to-day.

The trails from Lucban to Sampaloc and Mauban and to Majayjay were sufficient for saddle and pack horses. In some cases the grades were so steep that the trail was constructed as a series of steps.



Tayabas–Lucban Road, Tayabas Province, under construction.

While wheeled vehicles traveled the main roads emanating from the capital, they were probably never very plentiful and the usual mode of locomotion was the saddle horse or hammock. All municipios maintained hammock equipment and the rates were fixed.

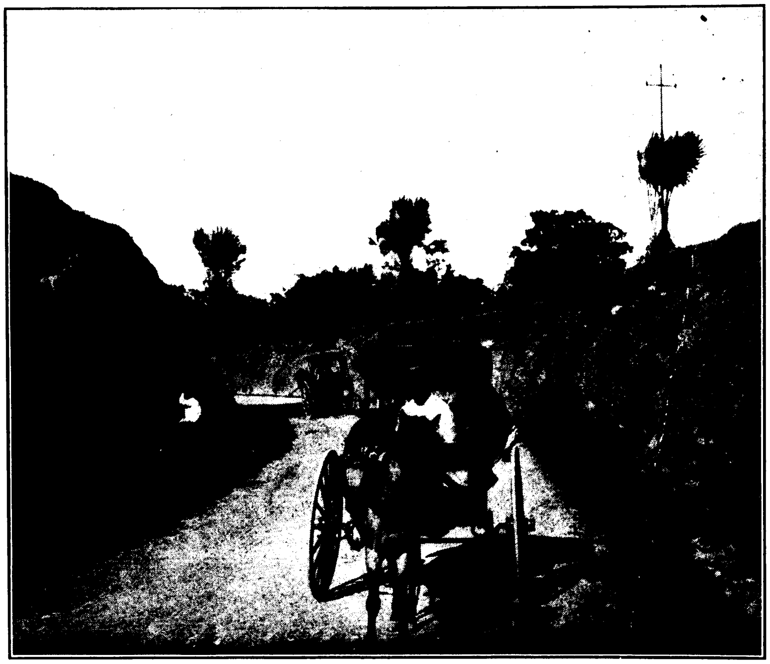
To-day, a broad highway, 40 kilometers long, extends from the western boundary to the new capital, Lucena; an automobile road, connecting Lucena and the Pacific Ocean at Atimonan, 41 kilometers distant, rivals the Benguet Road in alignment and setting and attains an elevation of 1,100 feet. A good road now connects Cotta, Lucena, and Tayabas. Later, an old Spanish road now under reconstruction will lead the traveller high up among the terraced rice fields in the foothills of Banahao to the town of Lucban, 24 kilometers from Lucena, famed for its hat-making industry and its cool climate. Dolores, Canda, and Gumaca are open to automobile traffic during the dry season, though the trip is difficult. Automobiles are a very common means of locomotion and numerous trucks transport copra and other freight to the railroad. The trip from Manila to Lucena of 138 kilometers requires only four hours by auto.

Pagbilao–Atimonan Road, Tayabas Province.

All completed roads are surfaced with hand-broken stone or hard gravel and in most cases have at least 4 meters wearing width and wide shoulders. The Lucena–Atimonan Road, however, is narrow and has sharp curves and heavy grades. Yet, when one considers that only as far back as the days of military operations an entire battalion was lost for several days in the hills between Lucena and Atimonan, one cannot but contrast their difficulties with the ease and pleasure of an auto ride, with vistas of Pagbilao Bay in the distance, dense orchid-laden tropical growth far below, and the drumming of the motor echoing through the hills. Built as an Army pack trail, the Atimonan Road has grown to be an automobile tourist route, the pack mule has been supplanted by the automobile, and the pleasure seeker finds no trace of the soldiers of yesterday. The whole is typical of progress.

Marinduque is already nearly half encircled by a good road, to which additions are being made each year.

From Boac, the capital of the subprovince of Marinduque, the road is completed only as far north as Mogpog. South of Boac, however, the road extends through the town of Gasan to Buenavista, where there are hot springs of medicinal value. A trail, mountainous and tedious, connects Buenavista, Torrijos, and Santa Cruz and completes the circuit of the island.



Kilometer 1, Lucena–Pagbilao Road, Tayabas Province.

Altogether, there are 133 kilometers of declared first-class roads in Tayabas, of which 34 kilometers are in Marinduque.

A project lately launched aims to extend a road down the western coast of the Bondoc Peninsula, thereby affording several isolated towns means of communication with the railroad. The trail from Lucban to Mauban affords horseback communication between these two towns and Sampaloc.

The isolated seacoast towns are being provided with the necessary roads to the landings as rapidly as funds permit, and the towns lying along the railroad are being connected to the nearest station; every effort is being made to facilitate the movement of the products of the province to their markets.

It is probable that 75 per cent of the labor employed in the construction of roads in Tayabas since 1908 has been supplied by adjoining provinces and in some cases provinces as distant as Ilocos Sur have furnished labor for public works. That the cost of labor is high and that the expenditures for public works in Tayabas should exceed those for similar projects in more-favored provinces is natural; yet such is the excellent quality of labor

The Zigzag on kilometer 25, Pagbilao–Atimonan Road, Tayabas Province.

secured that most of the work compares very favorably in quality and cost with the best to be found in the Islands.

All first-class roads are maintained by the district engineer under the "isolated caminero" system, which has been found effectual and fairly satisfactory. The only objection to this, or any other feasible system, is its cost, which may be inferred from the facts that common labor costs 80 centavos per day, capataces from ₱1.50 to ₱2.25 per day, and materials on a like scale. The appropriation for first-class maintenance for 1915 was ₱60,400 of which ₱7,000 pertains to Marinduque.

Second-class roads and trails are maintained under the "gang" system, an effort being made to keep these roads open to traffic and to improve them as much as the limited funds will permit. For 1915 there are ₱4,000 available for this work.

Of the present road-construction projects, that from Tayabas to Lucban is of most importance. The town of Lucban, in normal years, produces ₱600,000 worth of buntal hats, buntal being the fiber obtained from the buri palm. For years they have packed this valuable product and their other exports and imports over the precipitous trail to Majayjay or the rough road to Tayabas on pack horses. The heavy grades have made the use of carts impracticable and have practically isolated this wonderfully productive section of the province. Work is now being steadily pushed to cut down the grades, eliminate the abrupt curves, and convert this old Spanish road into a modern highway.

The surfacing for this work is being broken by hand, for which the stone breakers receive ₱1.50 per cubic meter. Stone for this purpose occurs all too plentifully in the cuts, and is of an igneous character, extremely hard to break. An idea of the character of the work involved may be obtained from the fact that over 2,000 cubic meters of earth and bowlders were taken out of a cut 200 meters long. The highest point on this road is about 1,500 feet above the sea.

The total cost of this project will be about ₱100,000, or an average of ₱9,000 per kilometer.

Other projects under construction are the road connecting Unisan with the railroad at Panaon and trail construction from Buenavista to Torrijos and from Santa Cruz to Mogpog.

It is expected that the Manila–South Road will be continued to Gumaca and further south, and that a road will be constructed to connect San Juan de Bocboc, in Batangas Province, to the Manila–South Road. The trail to Majayjay should be rebuilt as a first-class road to complete the circuit of Banahao and Lucban, Sampaloc, and Mauban connected with a good road. Much remains to be done on road construction and the question of funds alone prevents its realization.

BRIDGES.

Scattered along the more traveled routes are excellent examples of the constructive ability of the Spanish priests (who were almost invariably the "engineers" on provincial public works), of which "Princesa Bridge" is a type. They are all arched structures, built of rubble masonry laid in lime mortar. In practically every instance the larger structures are in excellent condition, though nothing has been done in the way of repairs for more than sixty years. The smaller culverts have suffered more in recent years than in the long period of their existence preceding the introduction of heavy carts and trucks. An examination of Spanish lime mortar masonry indicates a very high quality of lime and expert knowledge of its use.

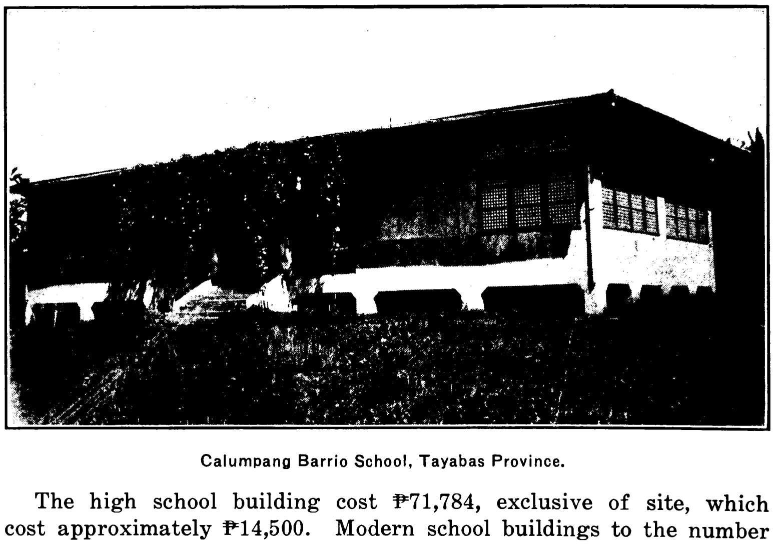
Fortunately, few large bridges have thus far been required in the road-construction program. The steel bridges spanning the Candelaria, Iyam, Dumacaa, and Pagsabañgon Rivers and the concrete slab and girder bridge at Gumaca are the longest so far constructed in Tayabas since 1898. There are no steel bridges now extant which were built by the Spanish Government. On the Manila–South Road, in the portion situated between Candelaria and Sariaya, there are small standard concrete structures, but for the most part the old Spanish culverts and bridges have been sufficient. It was in this section that the land slides of 1911, carrying thousands of tons of bowlders, sand, and gravel, were washed down the slopes of Banahao and carried out several bridges, culverts, and sections of road. New structures and spillways have long since replaced the destroyed ones and now only the initiated recognize the scene of the damage. Recently there have been constructed five standard pile-bent bridges on the Atimonan–Gumaca Road.

The records show that there are 312 bridges and culverts in the entire province, of which 105 are old Spanish structures and the remainder of modern construction divided as follows: Five steel bridges, total span 150 meters; 2 concrete arches, total span 29.77 meters; 24 slab and girder bridges, total span 336.11 meters; and the remainder minor box and pipe culverts of an aggregate span of 325 meters.

Princesa Bridge on Tayabas–Lucban Road.

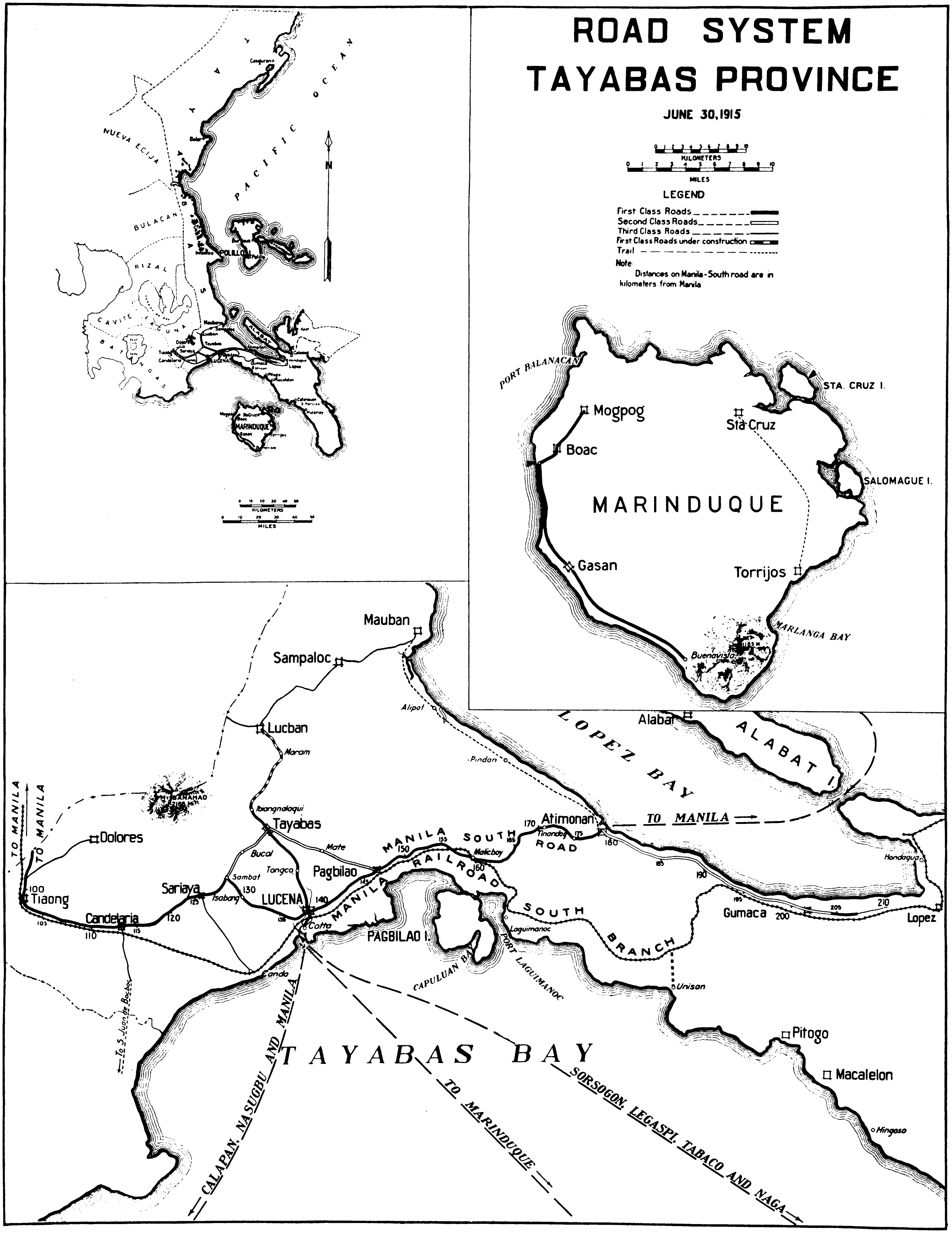
BUILDINGS.

The provincial building, prison, trade school, and corral are located on an adequate site in the southern part of the town of Lucena. The three buildings are of reinforced concrete and are strictly modern. The Provincial High School and Lucena Central School buildings are located a little over one-half a kilometer from the municipal building on the road to Sariaya, the former being a standard plan No. 20 building with four additional rooms and the latter a standard plan No. 10 structure. This will later be augmented by other structures and will form a very complete educational plant.



Calumpang Barrio School, Tayabas Province.

The high school building cost ₱71,784, exclusive of site, which cost approximately ₱14,500. Modern school buildings to the number of 12 have been constructed in other towns throughout the province, containing 94 classrooms altogether, while one more is under construction, at Mogpog, Marinduque, with plans underway for buildings at Infanta, Sariaya, Gasan, Tiaong and Pagbilao. There has been expended approximately ₱290,000 for modern school building construction.


ROAD SYSTEM
TAYABAS PROVINCE
JUNE 30, 1915
KILOMETERS
MILES
LEGEND
First Class Roads
Second Class Roads
Third Class Roads
First Class Roads under construction
Trail
Note:
Distances on Manila-South road are in kilometers from Manila
PACIFIC OCEAN
NUEVA ECIJA
BULACAN
RIZAL
CAVITE
LAGUNA
BATANGAS
POLILLO
MARINDUQUE
N
MARINDUQUE
PORT BALANACAN
Mogpog
Sta Cruz
STA. CRUZ I.
Boac
SALOMAGUE I.
Gasan
Torrijos
MARLANGA BAY
Buenavista
Mauban
Sampaloc
Alipol
Lucban
Maram
Pindan
LOPEZ BAY
Alabat
ALABAT I.
TO MANILA
TO MANILA
BANAHAO
Ibiangnalaqui
Tayabas
Dolores
Mate
Bucal
Tongco
Pagbilao
Sambat
Tiaong
Sariaya
Isabang
LUCENA
Candelaria
Cotta
PAGBILAO I.
MANILA SOUTH ROAD
MANILA RAILROAD
SOUTH BRANCH
Atimonan
Tinandog
Malicboy
TO MANILA
Hondagua
Gumaca
Lopez
Laguimanoc
PORT LAGUIMANOC
CAPULUAN BAY
Unisan
Pitogo
Macalelon
Hingoso
Canda
To S. Juan de Bocboc
TAYABAS BAY
CALAPAN, NASUGBU AND MANILA
TO MARINDUQUE
SORSOGON, LEGASPI, TABACO AND NAGA
100
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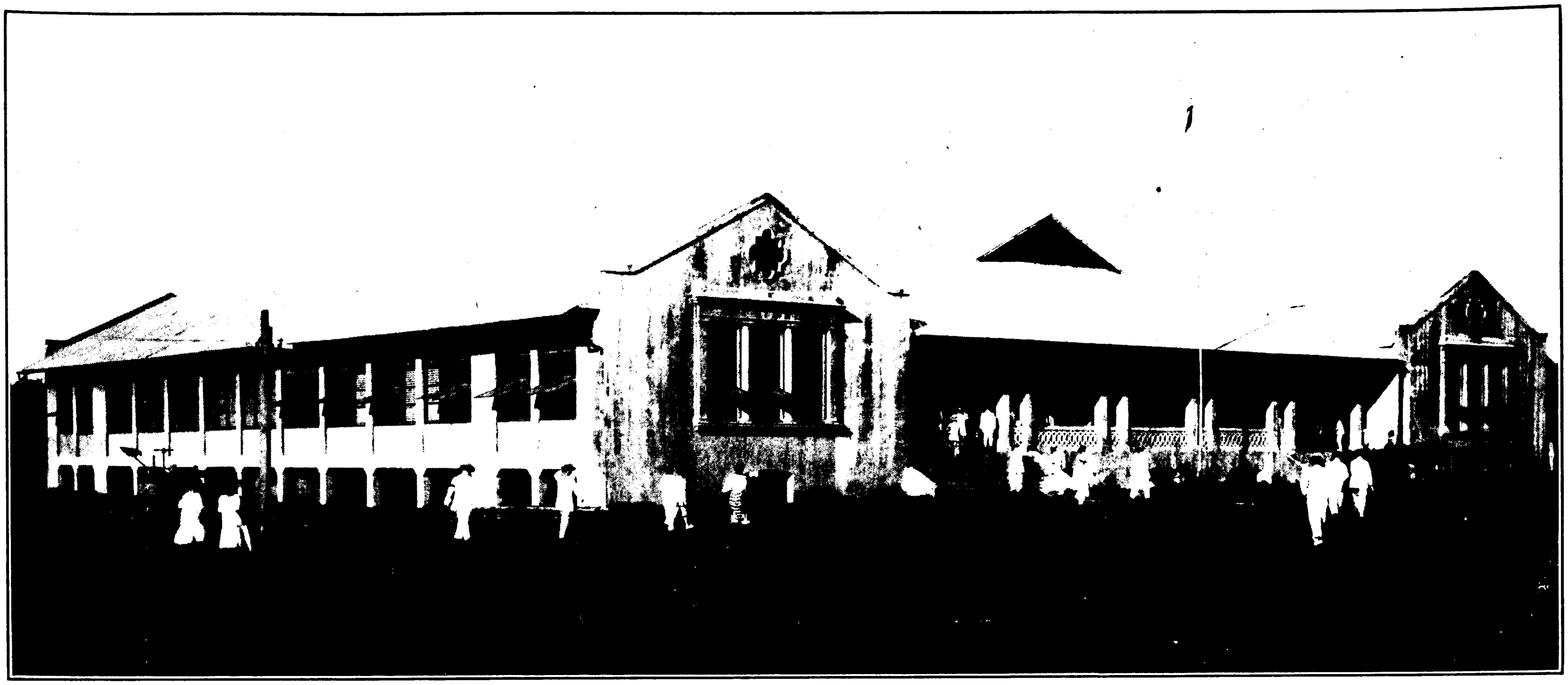
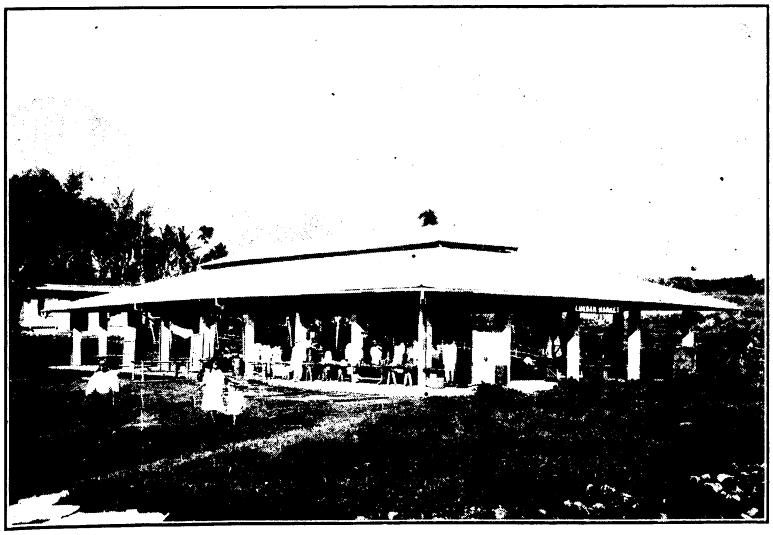


Lucena High School, Tayabas Province.

Modern market buildings have been constructed in Sariaya, Lucban, Lucena, Tayabas, Atimonan, and Mauban. These are all of durable construction, with concrete columns supporting wooden roof trusses and galvanized-iron roofs and having floors of concrete.

Plans have been prepared for market buildings at Tiaong, Candelaria, Pagbilao, Gumaca, Calauag, and at Boac and Santa Cruz, several of these projects being now ready to advertise.

The cost of market building construction has been higher than the average for the Islands, owing to the isolation of many of the projects; for example, the 24 by 42.8 meter, type B, building at Tayabas cost ₱20,730.74, and the 21 by 43.5 meter, type B, building at Atimonan cost approximately ₱18,000. The increased cost is due to the lack of local labor and high cost of transportation of materials.



New market at Lucban, Tayabas Province.

Municipal buildings of reinforced concrete have been constructed at Lucena and Mauban at a total cost of ₱27,400 and ₱28,978, respectively. The remainder of the towns all occupy old Spanish or temporary municipal buildings.

The only old Spanish buildings of any importance now existant are the churches. The Roman Catholic Church at Tayabas is an especially noteworthy example. This building was constructed of lime-mortar stone masonry with a galvanized-iron roof. The walls average 8 feet in thickness. From the top of the facade a beautiful view is obtained of the surrounding country, revealing more coconut trees than one would imagine existed. In the distance, the blue waters of Pagbilao Bay, dotted with islands, can be seen, and far away the mountains of Marinduque stand out in bold relief.

The church at Lucban is another fine example of early Spanish construction. A view of this structure appeared in the January 1, 1914, number of the QUARTERLY BULLETIN.

WATER SUPPLY AND IRRIGATION.

Prior to 1912, little had been done to provide water supply systems for the various municipalities of the province. Mauban has a public bath constructed by the friars, which utilizes a spring about 40 feet above the level of the streets of the town. In Lucban and Tayabas water from mountain streams runs through the gutters of the streets and, naturally, most of the "lavanderas" do their washing where they have such handy runing water and probably find the century-old masonry of the aqueducts very satisfactory as a place on which to beat the washing with their wooden paddles, but the water is amœba laden and is unfit for consumption.

During 1912, however, two modern systems were constructed, one at Sariaya and the other at Boac.

The municipality of Sariaya has a gravity water supply, furnishing spring water from Mount Banahao at about 125 pounds hydrant pressure. The entire system is not completed, but funds for this work and a public fountain are now available. The cost to date has been ₱37,935.

Boac, Marinduque, has a small pumping plant, delivering artesian-well water to a reservoir situated at a high point in the town, whence it is distributed by pipes. The total cost was ₱6,653.

Both of these projects have been described in previous issues of the QUARTERLY BULLETIN.

The completion of these two projects has stimulated interest in this branch of public improvement and plans are now being prepared for a combined system for Tayabas and Lucena, which will cost in the neighborhood of ₱185,000 and contemplates an hydroelectric plant for Tayabas as an adjunct project. The spring from which this supply will be obtained is located on the side of Banahao, 14.5 kilometers from Lucena and flows 3,000,000 gallons per day. The towns of Pagbilao, Lucban, and Guinyangan are considering water-supply projects, while plans have been prepared for a system for Santa Cruz, Marinduque.

Flowing artesian wells have been obtained in Lucena and Pagbilao, but the volcanic nature of the underlying strata has prevented the construction of this type of water supply in most cases. At Boac, several pumping artesian wells have been constructed.

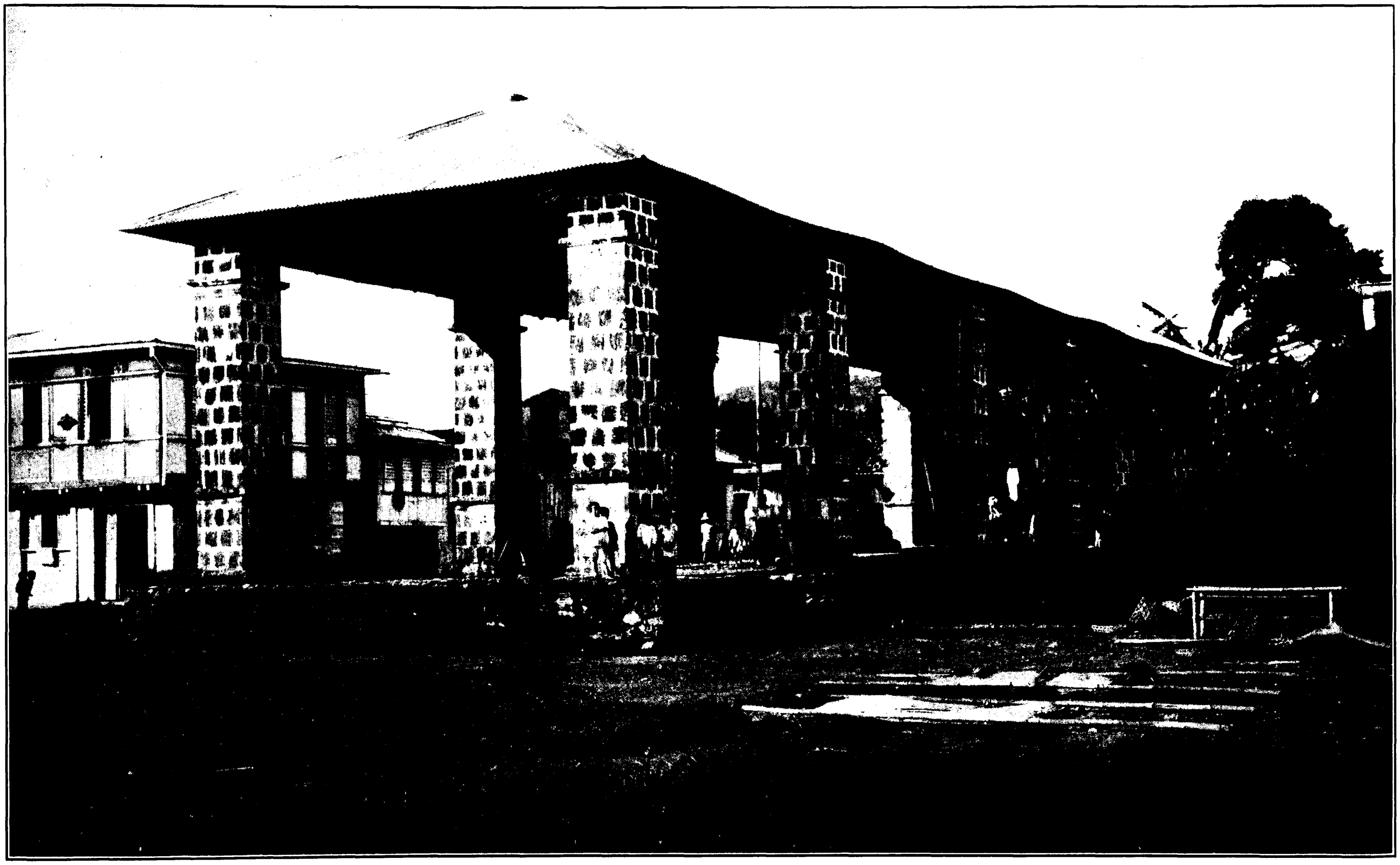
The entire country from Lucban to Tayabas is irrigated by means of diversion canals from springs and mountain streams. As a result, the crops never fail in this section and double crops of rice are raised annually. Throughout the province, advantage is taken of every opportunity to irrigate where the cost is not large, but no large projects have been undertaken.

It is probable that water could easily be diverted from the larger streams and used for irrigating coconut lands, thus obviating a repetition of the curtailed copra crop occasioned by the drought of 1914–15.

At Tayabas and Sampaloc a peculiar type of rice mill is found, power for which is obtained from undershot water wheels.

Hondagua, the present terminus of the railroad, has a beautiful harbor, capable of sheltering the largest ships. As the direct route to Hondagua will cut the time necessary to transport mail from the United States and Japan to Manila by two days and will obviate the necessity for passing through San Bernardino Straits or around the north capes, Hondagua seems destined to rival Manila as a port.

The railroad is completed to Laguimanoc, and construction track has been laid as far as Panaon. On the southern end, construction track is laid from Siain to Hondagua, and it is expected that the gap will be closed and trains in operation by the end of 1915. This will open up wide stretches of territory having poor transportation facilities at present.


Old market at Lucban, Tayabas Province.

Tayabas produces a variety of minerals—from pearls and gold to coal and petroleum; she has some of the richest stands of hardwood now extant; she produces ₱1,500,000 worth of hats every year and 35,000,000 kilos of copra per annum; all of which, with hemp and other products, return a normal annual income to her people of at least ₱20,000,000 per annum.

Botocan Falls and the Agos River offer many thousand horsepowers of undeveloped, cheap power, the latter having already been investigated with a view of supplying Manila with electric power for all purposes.

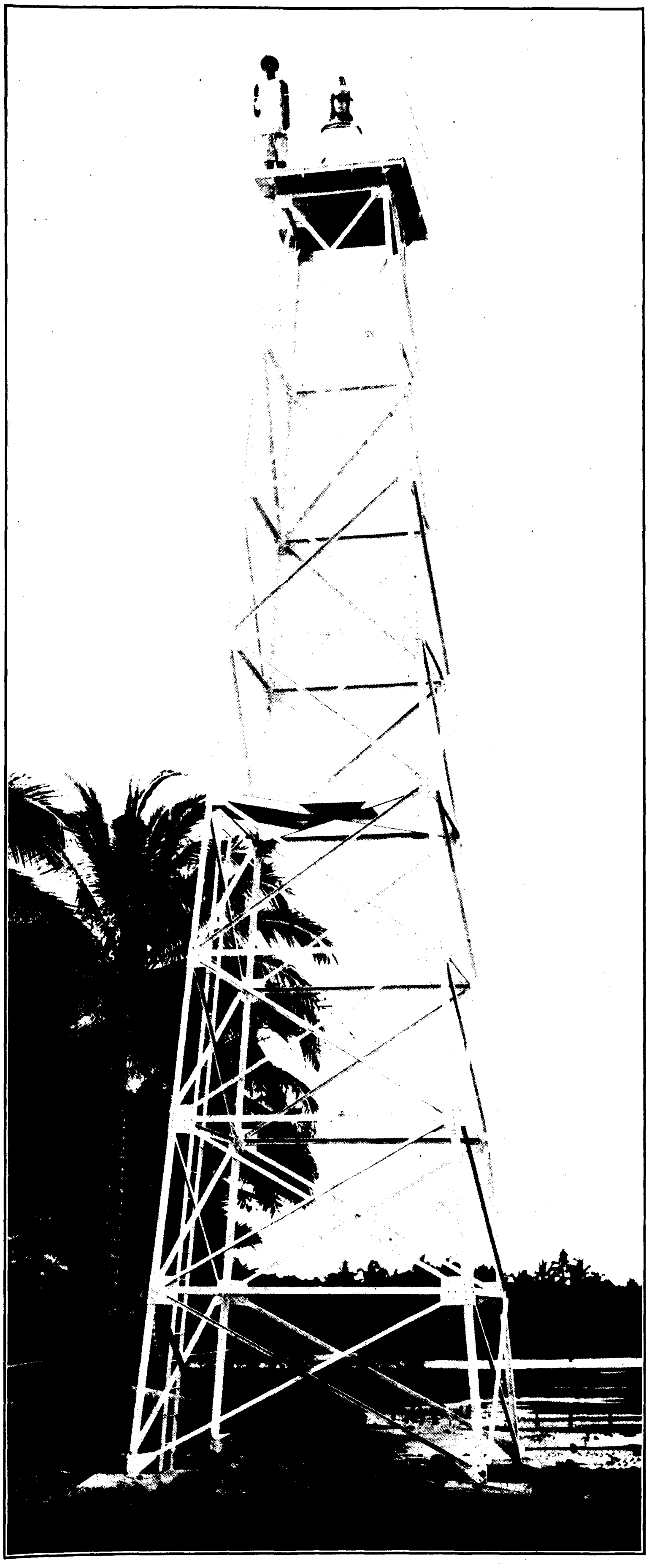
Altogether, from the records available, it appears that Tayabas Province has expended ₱852,220 for roads and bridges, ₱527,922 for public buildings, and ₱44,589 for water supply systems, etc., since the beginning of American Government.

PUBLIC UTILITIES AND COMMERCE.

Lucena has an incorporated electric light, water, and ice company; an hydroelectric plant is being installed at Lucban; Tayabas and Sariaya are perfecting plans for similar companies or municipal plants and various other towns are awakening to the need of more adequate municipal improvements of this kind.

A conservative estimate of the results of new assessment now underway places the assessed valuation of the entire province at not less than 50 millions of pesos.

Tayabas is young in her development and geographical conditions operate against rapid, consolidated progress; she is vastly underpopulated and clamors for laborers to do her work; yet every year sees thousands of new coconut trees planted; many new homesteads taken up; a few more bridges and buildings constructed; a few more kilometers of road built and the railroad creeping steadily southward. Those who know her cannot doubt that she will grow steadily by reason of her latent riches, until she ranks among the fairest and most prosperous provinces of the Archipelago.



Lucena lighthouse, Tayabas Province.

THE MOTOR TRUCK.

By J. L. HARRISON.

Engineering, like other professions, is subject to fads. Just now trucks are a fad. The man who has any hauling to do suspects himself of being behind the times if he does not own a truck. Often this suspicion is enough to influence him to get one. Sometimes he is right. Sometimes he is hopelessly wrong. Yet there is no good reason why an intelligent man, and particularly there is no reason at all why any engineer should buy a truck without being reasonably sure that it will be a profitable investment. But as trucks are now at their height as a fad, and as the presumption is, therefore, always in their favor, a few words in regard to the cost of operating them, and as to the conditions under which they must be operated in the provinces of the Philippine Islands, may not be out of place.

The possibility of securing low unit hauling costs by the purchase and operation of trucks depends on a number of general conditions among which may be mentioned (1) satisfactory roads, (2) facilities for quick loading, (3) plenty of material to haul, and (4) quick repairs. There are other matters which might be touched on but in a comparison between actual working conditions in the Philippine Islands and normal city conditions in the United States, these are the most important features to consider.

The cost of operating trucks is also influenced by local prices on tires, gasoline, etc., but this will not be discussed at length as the influence of local prices is usually well understood, though the influence of peculiar local conditions is often overlooked. Thus, if gasoline costs ₱0.30 per gallon in the United States and ₱3 per can of 4.5 gallons here, or if a driver costs ₱100 per month here and ₱150 to ₱200 there, these factors can be readily taken into consideration and proper allowance made for them. Nor will the theory of a proper allowance for depreciation or other such factors be commented on. They are too well established to demand any special attention. Suffice it to say that, from the costs shown in Tables I and II, the data for the compilation of which were taken from the files of Engineering and Contracting, ₱0.30 has been obtained as the kilometer meter cost that would have resulted from operating 5-ton trucks under favorable city conditions had the Philippine prices on oil, gasoline, tires, etc., ruled. A consultation of the tables mentioned shows that the average conditions recorded for the trucks mentioned were: (1) paved city streets, (2) loading bins such as to permit of loading in from six to ten minutes, (3) about 80 kilometers travel per day under full load one way, (4) garages in which all minor repairs can be made. Repair parts ordered by telegraph are always procurable in Manila, within two or three days, usually within twelve to twenty-four hours. The determination of the advisability of using trucks in any province of the Philippine Islands will depend on the extent to which it can be shown that provincial conditions will affect this probable average city cost of ₱0.30 per kilometer meter which may quite accurately be styled the probable average cost per kilometer meter for heavy truck transportation in the city of Manila, and the relation that can be shown to exist between the probable provincial cost per kilometer meter and the cost of local transportation.

1. Any truck purchased for use in connection with provincial construction work will, of necessity, be used almost entirely in the maintenance and construction of roads. The present road system consists of first-class highways open to heavy traffic throughout the year; second-class highways, surfaced and passable during all but the very wettest periods; and third-class roads, not surfaced at all and therefore impassable for trucks except during the dry season. The rainfall of different parts of the Philippine Islands ranges from less than 40 inches to over 120 inches a year. Also, the duration of the wet season varies considerably. In central Luzon the dry season usually lasts at least six months, while on many of the southern islands there is practically no dry season at all. As it is quite impossible to operate a truck over earth roads except during the dry season, this means that trucks purchased for use in central Luzon can be operated almost anywhere for six months in the year, but that all loads carried during the balance of the year must be carried over the im-

proved roads, and that in many parts of the southern islands there can be no assurance that trucks can be of any use whatever unless they are operated over improved roads.

Moreover, it is not likely that heavy trucks can be continuously operated over even the first-class road system in the wettest season of the year. Many parts of the Philippine Islands are low and during the wet season become boggy. The first-class roads in the Philippine Islands will compare favorably with any in the world, but there is no use in denying that the best form of highway construction ever devised would fail under the strain of constantly passing loaded 5-ton trucks if it was supported on nothing better than rice-field mud. Engineers will probally find, therefore, that there will be two or three months each year where constant trucking over lowland roads damages the roads to an extent that is out of all proportion to the value of the hauling. Nor is this idea based solely on theory. It is based on careful observation of the action of heavy rollers and traction engines. In fact, it might be noted in this connection that one of the many reasons for abandoning the use of traction engines was that they could not operate over earth roads except in the driest weather and that in the wet season they cut up and rutted even the best of metaled roads. The contention that the continuity of the improved road system, the amount of lowland road, the length of the dry season, etc., will prove to be important features in the successful operation of trucks would seem, therefore, to have a reasonnable basis in the experience already had with other forms of tractive machinery. Some of these factors will undoubtedly affect the economy of truck transportation less than they affected the economy of traction-engine transportation, but that all will have some adverse effect even on truck transportation will be at once recognized if they are carefully studied and if the cost of delays is considered.

A matter of minor importance, but one that deserves mention in this connection, is the fact that heavy trucks cannot be turned around on a standard subgrade. Therefore, if trucks are to be operated it will usually be necessary to construct and surface places where the trucks can be turned. The cost of this work and of maintaining it must be considered in computing the cost of truck transportation. Nor will this be any small item. In provinces having 100 kilometers or more of first-class highway, the cost of providing places for turning trucks around will amount to a good many hundred pesos.

As a comparison with city conditions under which heavy trucks can operate freely the year around, it may be safely contended that (*a*) there is no province in the Philippine Islands where trucks can operate independent of the improved road system for over six months every year, and (*b*) that even where the improved road system is extensive enough to provide employment for trucks during the wet season, it will often be found that heavy trucking must be abandoned over periods of from a few weeks to two or three months because of soft subgrades. Roughly speaking, the operation of a 5-ton truck costs ₱10,500 a year. About one-third of this cost is in fixed charges. In other words, working or standing still, the fixed charges on a 5-ton truck approach ₱12 a day. Looked at in another way, a truck is supposed to work 300 days a year, working, say, 80 kilometers a day. If this truck only works 250 days the annual cost will fall to ₱9,400, but the kilometer meter cost for the year will rise from ₱0.30 to ₱0.32, an increase of about 6 per cent.

2. The next feature to be considered is proper loading facilities. In the estimates and records from which Tables I and II are compiled, it is made clear that if a truck is to be effectively handled it must be loaded quickly. For example, if a truck is costing a province ₱35 a day and operates, say, ten hours a day (more frequently it will operate eight or nine hours), the time of this truck is worth nearly ₱0.06 per minute. Loading by hand will probably take thirty minutes, where loading from properly designed bins can be accomplished in ten minutes or less. This loss of ₱1.20 every time a truck is loaded by hand will have a marked effect on the efficiency of the truck. For instance, suppose the truck travels 12 kilometers an hour, about an average rate for heavy trucks. If hauling and dumping take an hour and ten minutes, 6 trips can be made in a day. The loss due to faulty loading facilities will then be ₱7.20 a day and the unit cost for hauling will be increased from about ₱0.25 to about ₱0.32 per kilometer meter. On the other hand, the cost of installing proper loading bins and the cost of such elevating machinery as is needed in operating the loading bins, together with the cost of maintaining the same, so far as these improvements involve an increase over the present cost of loading carts, must be included in the cost of truck transportation.

Another matter that should receive consideration is the question of the roads to the gravel pits and quarries. At present it is not necessary to build expensive roads into either quarries or gravel pits. They are worked almost entirely during the drier seasons, and if it is assumed that wet weather may prevail, just enough stone or gravel is thrown into the roads to support loaded carts on wet days. If a truck is to be used, this condition will be changed entirely. Not only will it be necessary to provide roads that will carry the truck during the drier periods but, as low unit costs require that the truck be used at least 300 days in the year, provincial work must be so planned that there will be work for the truck to do at all seasons of the year. This will ordinarily mean that the truck will haul maintenance materials during the wet season. This, in turn, will necessitate the construction of roads heavy enough to enable the truck to reach those quarries or gravel bars which supply maintenance materials at all times in the year. It would not take much of such construction to make the investment in the roads built in order to reach the gravel and stone supplies greater than the investment in the truck for which these roads had to be built.

Last, even if gravel pits and quarries are favorably located in respect to their distance from the main roads, it will often happen that provision must be made to reduce unduly steep grades, to obviate difficulty with sand, and to provide stronger bridges over creeks, small draws, etc. These changes may not amount to much on any one project, but in a season's work they may require a considerable outlay. In fact, any engineer who endeavors to ascertain the number and cost of the minor changes he will have to make in order to operate a truck in his province 300 days every year will be more than surprised at what he finds.

Summarizing, it would appear that where, for city work, one good, well-located loading station might suffice to serve a large number of trucks, the provincial engineer will be confronted by the problem of either installing a more or less temporary loading station at each important gravel bar or quarry or of moving one temporary loading station every time his truck is required to load from a new gravel bar or of having to increase the unit cost of hauling from 10 to 30 per cent because of the time lost in loading by hand. No one of these options is desirable. Each one, in fact, serves to show the advantage that a big, well-equipped city fleet has over a single provincial machine in the matter of securing low unit costs, and when the disadvantage of the high cost of building and maintaining loading stations for one or two trucks is increased by the further disadvantage resulting from the cost of constructing roads to the loading stations, and of strengthening temporary bridges, reducing grades out of gravel pits, etc., the cost of loading will be found to very materially and very adversely affect the unit cost of handling gravel and stone by means of modern trucks operated under the conditions ordinarily obtaining in the provinces of the Philippine Islands.

3. In purchasing a truck very few men stop to consider the really enormous quantities of material that it will carry in a year. Eighty kilometers a day, loaded one way, is a reasonable demand where there are proper loading facilities. At a very slight overload a 5-ton truck will carry 3 cubic meters of broken stone or screened gravel. Working 300 days in a year, this means that the enormous quantity of 36,000 cubic meters of stone would be transported 1 kilometer, or over 7,000 cubic meters of stone would be transported 5 kilometers. There are provinces where this amount of stone is moved every year, but it is believed that if the problem is approached from this angle engineers will ordinarily decide that the conditions in most of the provinces of the Philippine Islands are such that it will be hard to find the number of loads necessary in order to keep a heavy truck

busy the year around. It will be especially hard to keep it busy during the season when construction work is largely closed down.

4. Not the least important factor in a consideration of the advisability of using motor trucks is the accessibility of facilities for making repairs. Years ago this was impressed on the writer by a break down on a traction engine. The Province of Leyte had purchased a traction engine and a string of cars and was planning to haul rock for a new road. Just at the beginning of the dry season, and after only about a week's work, a couple of teeth were broken out of the drive pinion and the machine was hopelessly disabled. A rush order for a new part was sent in. Nothing seemed to avail to hurry the delivery of the new pinion. Days ran into weeks and weeks into months, but the new part was not received. Finally, after the dry season was all over, the new pinion, just arrived from the United States, was sent out. This was an extreme case even for the conditions prevailing six years ago, but it serves well to illustrate the fact that, outside of Manila and its immediate environs, the breaking of even a simple part may mean weeks of delay. As was shown before, the fixed expense of operating a truck will be about ₱12 per day, so the cost of break downs may be expected to cause an indirect loss that approaches the actual cost of the repairs themselves. The amount that the loss of time due to breakdowns will affect the unit cost of truck transportation will vary according to the accessibility of the province in which the truck is working, but distance from Manila will always have some effect on unit costs and it will always be an undesirable effect. It might be added in this connection that the facilities of the Manila machine shops have so greatly improved within the past five years that it is now rarely necessary to send to the States for spare parts. The delays that result from breakdowns are caused by the poor transportation facilities of the Islands and by the actual time required for shopwork in Manila.

In order to show more clearly the effect that local conditions may be expected to have on the cost of truck transportation, the following table has been developed:

Cost of operating one 5-ton truck.

Capital investment.	Good conditions in the United States.	Provincial conditions in the Philippine Islands, based on conditions in Bulacan Province.	
		With improvements sufficient to secure 240 days' work per year.	With no improvements, truck used one-half year.
Cost of truck	₱10,000	₱12,000	₱12,000
Turnouts along road[a]		2,000	
Loading station[b]		2,500	
Roads to pits[c]		7,500	
Fixed charges:			
Driver	2,040	1,200	1,200
Garage	600	500	300
Insurance	380	500	500
Interest on cost of truck[d]	250	300	300
Interest on road, loading stations, etc		300	
Variable charges:[e]			
Depreciation on truck	1,340	1,285	600
Tires	2,025	2,000	915
Repairs	1,000	1,200	600
Gasoline	1,540	2,250	1,100
Oil, waste, etc	120	200	100
Maintenance and repairs of roads		500	
Maintenance and depreciation of loading station		750	
Temporary structures, grade corrections, and temporary roads		750	
	9,396	11,735	5,615
Use of time:			
Sundays	52	52	52
Holidays	6	12	12
Repairs	3	16	11
Bad weather or impassable roads	4	25	
Half load due to soft subgrade		20	
Laid up during wet season			150
Full work	300	240	140
Distance traveled ... kilometers	[f] 24,000	[f] 19,200	[g] 8,400
Kilometer meters, at 3 meters per load, one day	36,000	27,800	12,600
Cost per kilometer meter	₱0.26	₱0.42	₱0.45

The present high cost of local transportation is the direct result of the loss of a very large percentage of the normal number of carabaos during a rinderpest epidemic that devastated the herds about twelve years ago. In this epidemic many provinces are said to have lost 90 per cent of the animals left after the disturbances attending American occupation. The natural result of the death of the carabaos, which are the work animals of the Philippine Islands, was a sharp increase in the price charged for hauling. But as the years pass, the herds increase in number and size and the price of hauling falls. Roughly speaking, a man with a team usually commands about twice the wage of a man who works without a team. The wages of an ordinary Filipino laborer outside of Manila may be said to range from ₱0.40 to ₱0.75 per day with a prevailing wage of about ₱0.60 in most provinces. It may be fairly assumed, therefore, that when animals become plentiful a carabao and cart with a driver will probably be obtainable at from ₱0.75 to ₱1.75 per day with the usual price at about ₱1.25 per day. Nor is this at all an idle dream. The price of local transportation has fallen steadily during the past five years and if the herds of carabaos increase it will continue to fall during the next five years. Four years ago, in Albay Province a man expected to receive ₱3 per day for a carabao and cart with a driver. He sometimes got more. He rarely got less. Three years ago owners asked ₱0.60 per kilometer meter for gravel hauled in Bulacan Province and regularly demanded ₱2.25 to ₱2.50 per day for a cart, carabao, and driver. Now, during the construction period, carts can usually be secured for about ₱0.35 per kilometer meter, and on a long haul they have been secured for as little as ₱0.27 per kilometer meter. So the contention that the price of transportation is falling is seen to be anything but a fiction. In fact, the cost of transportation has dropped more than 30 per cent in Bulacan Province within three years. If it drops at the same rate for a very few years more it will be possible to secure it at what is probably about a normal rate for this province, namely, ₱1.25 per day for a cart and carabao with its driver.

A carabao will travel from 20 to 25 kilometers a day. It will do this easily if night work, which the drivers prefer, is permitted, and will haul 0.6 of a cubic meter of stone over a level road. This is equivalent to approximately 6.5 kilometer meters at ₱1.25, or ₱0.19 per kilometer meter. The drivers load their own carts. This is certainly cheaper than the price at which trucks can do such hauling under the most favorable circumstances, and less than half of what a district engineer may expect truck hauling to cost under ordinary provincial conditions. It would seem fair, therefore, to suggest that the present high cost of local transportation is not ample justification for the purchase of expensive trucks. If the unit cost of local transportation is high, that does not represent normal conditions. It represents abnormal conditions. A truck must, to pay for itself, operate about ten years. It is not enough, therefore, to show that local transportation is now more expensive than truck transportation. To justify the expense involved in the purchase of a truck, it should be shown that past conditions and present indications all point to the fact that the cost of local transportation is likely to continue to be more expensive than truck transportation for the next ten years, for, if the cost of local transportation drops below the cost of truck transportation, the truck will be functionally obsolete and further operation will be at a loss to the owner. A failure to recognize this fact is bound to lead to losses, though in Government work such losses as those due to functional deterioration are often overlooked.

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[a] It is assumed that a place to turn a truck around must be provided every kilometer along the roads that are to be served during the wet season. These will be necessary, as trucks are expected to haul maintenance material during the wet season and the shoulders are not strong enough to carry a truck at that time of the year.

[b] The cost of the loading station and of its maintenance is included as a charge against the cost of hauling by truck, because in most provinces no such equipment is now used and its construction would be made necessary solely by reason of the purchase of a truck or trucks. The operation of the loading plant is not so charged, because it is assumed that there will be neither saving nor loss in the actual cost per cubic meter of material loaded, but merely a saving in the time of loading the trucks. This assumption may be questioned by some, but is based on some considerable experience with machines of various classes operated under provincial conditions.

[c] Two and one-half kilometers of road to connect existing roads with three gravel pits. These roads would be absolutely necessary if maintenance material were hauled during the wet season.

[d] Interest is computed at 5 per cent for States conditions. The same rate is used for the provincial truck, because 5 per cent is approximately the rate at which the Government could now borrow money. The average interest is used, as a flat rate of depreciation instead of an amortized depreciation has been employed.

[e] Depreciation is computed on the assumption that a truck will run 100,000 miles. Repairs are estimated at a 50 per cent advance over States prices.

[f] 80 kilometers per day.

[g] 60 kilometers per day; hand loading.

Gasoline is estimated at current Philippine Islands prices.

Tires are estimated at 20 per cent over States prices.

The maintenance cost for the roads to the gravel bars is estimated at ₱200 per kilometer. No depreciation has been allowed on these roads, as it is thought that with nothing but truck traffic over them there should be no deterioration with this amount of maintenance.

The cost of temporary structures, roads to new gravel pits, grade corrections, and temporary roads over sand bars will depend on the amount of new work undertaken every year. It is thought that in any province which is doing much work, minor improvements will average to cost at least ₱750 per year more than is at present spent for such purposes.

An important factor in considering the advisability of purchasing a truck is its rate of functional deterioration. This is usually omitted from estimates of the cost of transportation as made up in the United States, because it is assumed there that within the normal life of a truck (six to ten years) there will be no changes in either the kind or the efficiency of transportation that will render a modern truck inefficient. Can the same assumption be made in the Philippine Islands? Probably not.

Last, it should be emphasized that there is an economic side to this question. Where a truck is bought, its costs, and most of the money that is spent in operating it, go toward the payment for supplies that come from outside of the province, often from outside of the Islands. Money so spent never does much work inside of the province spending it. On the other hand, money paid to cart drivers who are residents of the province circulates in the province and stimulates business at home. Some will claim that this is a narrow view of the matter, but most men will agree that the proper way to build up strong local bodies of cart owners who are able and willing to haul for a reasonable figure is to spend transportation funds at home rather than to spend them in purchasing oil and gasoline in Manila.

On the whole, therefore, it is not contended that there is no place for trucks in the provinces of the Philippine Islands. There is undoubtedly some legitimate demand for them. But it is contended that there are a number of factors, often overlooked, which make it probable that the unit cost per kilometer meter for provincial truck transportation will considerably exceed what it is ordinarily calculated to be. In fact, it is felt that field engineers should not expect a figure below ₱0.40 per kilometer meter for average truck hauling, and that they should frankly face the fact that long before a good truck can be worn out, local transportation will probable be obtainable for much less than this figure. If, in spite of this probable high cost of operating trucks, and in spite of the fact that trucks are already functionally obsolete in some provinces and before long are bound to be functionally obsolete in all, a saving can be shown, a truck should be purchased, but it should never be purchased because "everybody's doing it," for a lot of those who are, have not figured up to the whole cost.

TABLE I.—*Estimated of cost for operating a 5-ton truck.*

Make of truck.	Trucks.	Capacity.	Fixed charges.	Variable charges.	Total cost per annum.	Cost per day.	Days used.	Kilometersrun perday.
		Tons.						
Mack [a]	3	7	₱13,150	₱17,665	₱30,815	₱34	300	64
Estimate [b]	1	5	3,310	6,020	9,330	31	300	80
Locomobile [d]	1	5	3,925	2,473	6,398	28	227	80
Do. [d]	1	5	3,196	1,736	4,932	25	194	86
Estimate [e]	1	5			8,145	27	300	80
Manila [f]	1	5	3,100	7,600	10,600	35	300	80

Make of truck.	Cost per kilometer meter.	Special loading devices?	City or country work.	Kind of material to be hauled.
Mack [a]	₱0.29	Yes	City	Sand and gravel.
Estimate [b]	.26	(c)	(c)	
Locomobile [d]	.23	Yes	Country	Heavy pipe.
Do. [d]	.20	Yes	do	Do.
Estimate [e]	.23	Yes	City	Street maintenance.
Manila [f]	.30	Yes	do	Do.

[a] Estimated by R. W. Hutchinson, jr.
[b] Estimated by Clinton Brettell, of the Locomobile Co.
[c] No assumptions mentioned.
[d] Data contributed to Engineering and Contracting.
[e] Estimated by A. F. Masury.
[f] Average of estimates for 5-ton trucks corrected for Manila conditions.

Average cost per kilometer meter, States condition, ₱0.23.

Average cost per kilometer meter, city conditions, Philippine prices, tires, gasoline, etc., ₱0.30.

TABLE II.—*Long and short haul unit costs to be expected from operating a 5-ton truck.*

Distance in kilometers.	Cost of truck hauling per kilometer meter for distances shown.		
	A.	B.	C.
0.8	₱0.59	₱0.53	₱0.58
1.6	.36	.35	.35
2.4	.30		
3.2	.27	.26	.26
4	.23		
4.8	.21	.23	
5.6	.21		
6.4	.21	.22	.22
7.2	.22		
8	.20	.21	
16			.19

A. Estimate by D. E. McComb for hauling asphaltic materials over city streets, Washington, D. C., by means of 5-ton trucks.
B. Study by efficiency division of the civil service commission of Chicago with reference to hauling broken stone, etc., for city streets.
C. Data prepared by Troy Wagon Works Co. from their own tests.

THE TERMITE (WHITE ANT) AND ITS PREVENTION AND EXTERMINATION.

By A. G. YANKEY, C. E., Assistant Engineer, B. P. W., Department of Mindanao and Sulu.

Everyone in the Tropics is more or less familiar with the ravages made by the termite, more commonly known as anay or white ant; but since it differs materially from a true ant and is rarely white, this common designation is very deceptive and should not be used.

The termite is found only in warm climates. The Philippines appear to be an ideal place for the termites, although they grow to a large size in both Africa and South America. Their principal food is soft woods; however, some eat fungi growing in their nests, others cut and store grass, while others prepare a peculiar kind of food by mixing the bark and gum of trees to make a tough, dry substance which requires moistening before consumption.

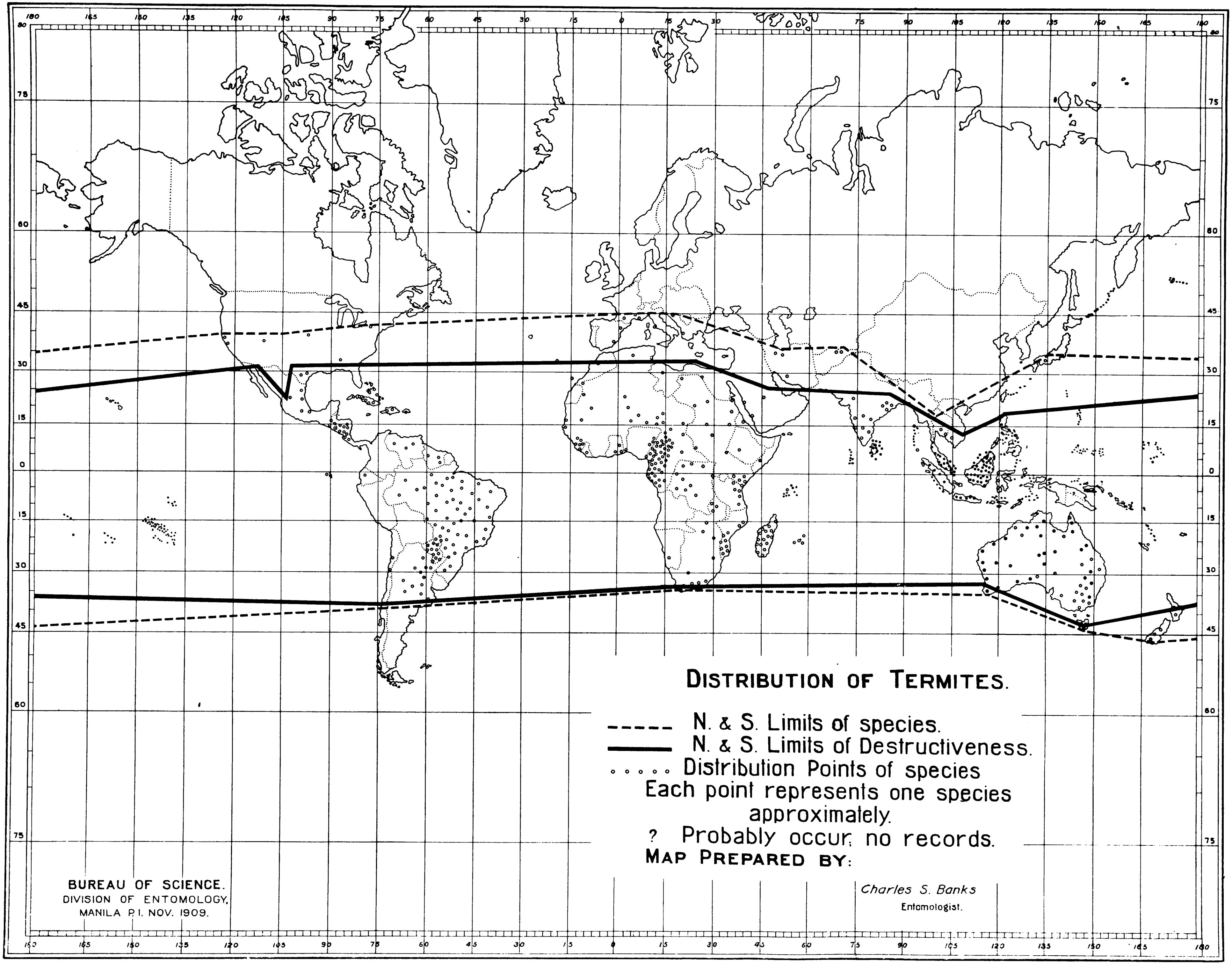
The termite is an insect with six legs and four wings, the latter being nearly all of one size—that is, long and narrow in form—and of paperlike consistency, which in repose lie flat on the back of the insect so that only one wing shows. After a short time the wings are shed, and only small stumps are left as evidence of the individual being a winged insect, although a large proportion of them become adult without wings appearing at all. The mouth is most peculiarly adapted to the work of boring, its jaws being composed of a substance as tough as iron and sharp enough to make progress in all but the hardest of woods.

The termites are social insects, many individuals of different form living in one nest, or termitarium. One of the most remarkable features of their existence is that the reproduction of the species in each community is confined to a single pair, or to a very limited number of individuals. The members of one colony, however numerous or dissimilar, are the descendants of a single pair. The colony is first started by a pair of winged individuals, who cast their wings, secrete themselves in a suitable place (preferrably a nest in the ground), and produce young.

This colony, due to the extreme fertility of the reproductive pair, who are believed to produce at the rate of 40,000 per day, develops very rapidly and lives for years.

In regard to the forms or castes, termites differ totally from other social insects, inasmuch as there is very little difference between the males and females and that the castes have no relation to sex. Since there is normally only a single pair of reproductive individuals in each colony, the community is thrown into a state of chaos when anything goes wrong with the royal pair. This disorganization is mitigated, however, by a method which termites have of keeping some individuals in an undifferentiated state, and of turning a pair of them speedily into reproductive individuals, thereby restoring the natural condition of activity and growth.

Apart from the forms that are merely juvenile, the following kinds



DISTRIBUTION OF TERMITES.

---- N. & S. Limits of species.
━━━ N. & S. Limits of Destructiveness.
○ ○ ○ ○ ○ Distribution Points of species
Each point represents one species approximately.
? Probably occur, no records.
MAP PREPARED BY:
Charles S. Banks
Entomologist.
BUREAU OF SCIENCE.
DIVISION OF ENTOMOLOGY,
MANILA P.I. NOV. 1909.

Copied from enlargement of Bureau of Science plan.
July 17, 1915.

of adults are normally present in a colony: (1) Workers, (2) soldiers, (3) winged individuals ready to leave the nest, and (4) king or queen.

The worker.—The worker termite resembles the young in general appearance, and, like the juvenile, has no trace of wings. The head is much larger in proportion to the remainder of the body. The color is distinctly different in different stages of development, being white in the young and of various colors in the full-grown workers, depending upon the species and its environment, but it is never milky white. The worker, as found here, is blind, although a comparatively few species have rudimentary eyes. They look after the eggs and young in addition to performing most if not all of the industrial work of the community. In some cases they are effective combatants, although not equipped with any special physical structures, as are the soldiers, to adapt them for this purpose. Workers form a very large but variable proportion of the colony population, running as high as 70 per cent.

The soldier.—The soldier termite is the most extraordinary and varied of any of the castes, being the means by which the species can be determined. The chief feature of the soldier is an extraordinary development of the head and mandibles. There are two very distinct kinds of soldiers: (*a*) The flat-headed or mandibulate soldier and (*b*) the nasute or rostrate soldier. In the former the head is usually developed out of all proportion to the rest of the body, giving an appearance of deformity. The nasute soldier has a thick, convex head better described as a unicorn, being prolonged in the center, forming a single, pointed horn. No species of termite has both kinds of soldiers. The one most commonly found in the Philippines is the nasute soldier with a modified head, being flat and having two small horns instead of one large horn. They are both blind and wingless. The mandibulate soldiers use their heads as blocks to stop canals in the nests, making threatening motions and producing noises by movement of their head and thorax, while the nasute soldiers emit a fluid from the tip of the rostrum and dab it on their enemies, rendering them less active. Those with two horns have considerable strength, being able to make painful pinches on the flesh, which, if applied to ants, would kill them instantly. They are very reliant, effective soldiers, being always on guard and ready for action. Their color is a reddish brown, which becomes darker with age.

Adult or winged termites.—Such of the young that do not become workers or soldiers grow and develop. During the processes of moulting the wing stubs gradually increase in size, the eyes appear, and finally pigmentation takes place; at the last moult the winged insect is perfected.

In prosperous colonies they are produced in large numbers, but have extremely feeble powers of flight and apparently little capability for anything, although they have well-developed eyes and more color than any of the other castes. The function of these adults is to diffuse the species and to favor crossing outside the colony. Very few of this form are found in the Philippines, although more often in nests of the field than in wooden structures.

King and queen.—Ordinarily each colony has only one pair of individuals capable of reproduction; those are the royal pair, or king and queen which are adult termites that have shed their wings. The queen usually undergoes an extraordinary increase in the size of the abdomen, which is sometimes distended to many hundred times its original capacity.

In many cases the king and queen are confined to their cell, although the workers, being much smaller, can get in and out to tend them. In other cases the queen only is imprisoned, and in others neither king nor queen is confined. In the Philippines the queen has more often been found closed in the cell.

The reproduction takes place only after the royal pair have cast their wings and established themselves together.

Neotecnic and substitution forms.—When a colony of termites loses the king and queen, it can replace them by forms specially prepared. There are two kinds of substitution forms—normal adult individuals and neotecnic forms—the latter being unnatural kings and queens possessing reproductive powers, although the wings have never been fully developed. This substitution in most cases is believed to take place within three or four months after the loss of the royal pair.

ORIGIN OF THE CASTES.

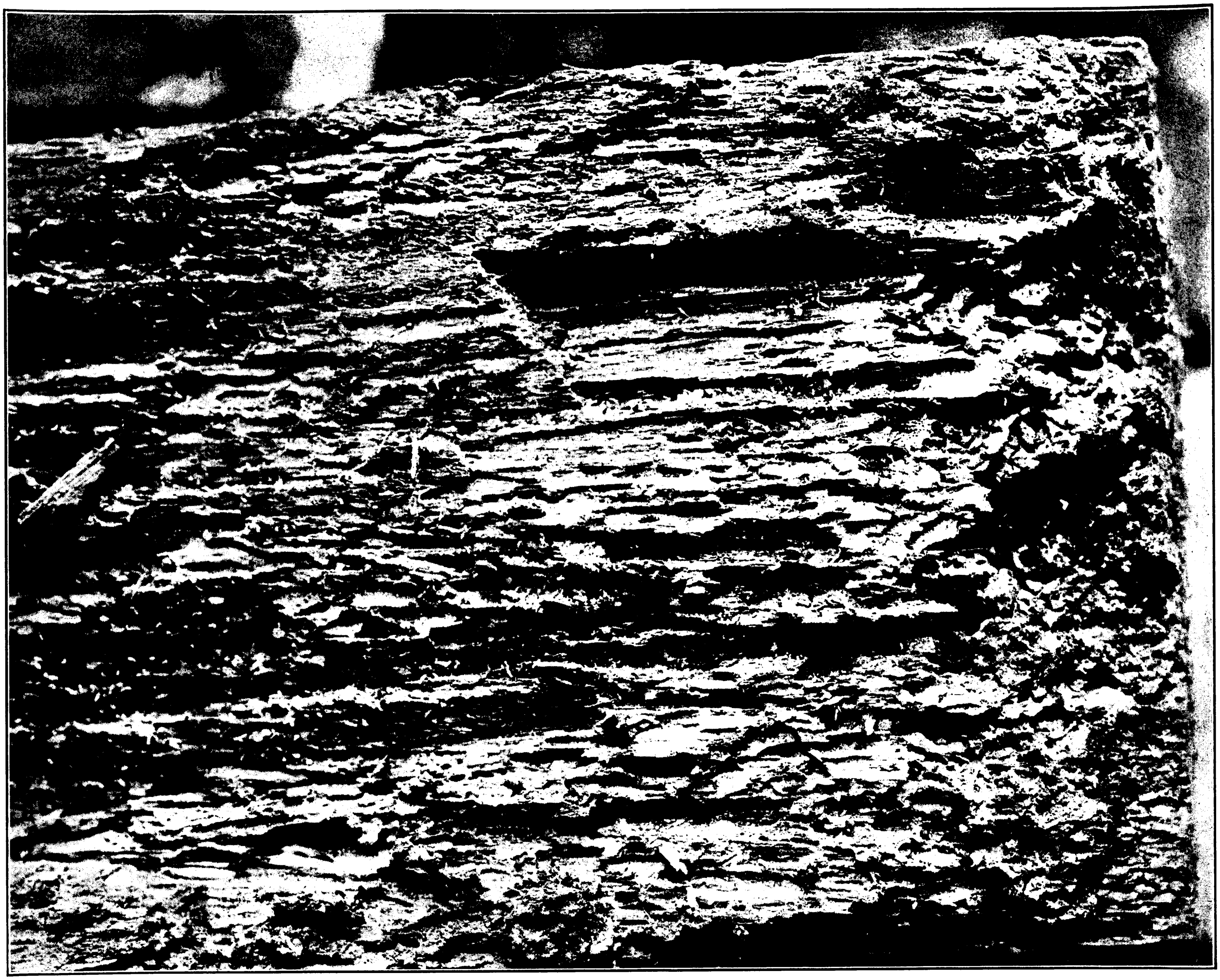
When termites are hatched from the eggs, little difference in the individuals can be detected. Very little is known as to when the changes take place, but it is believed, due to different treatment and foods, that they occur after their growth is to some extent accomplished. The soldier presents the most difficult problem, since its special structure bears no approximation to any characteristic of its parents.

Termitaria, the technical name for the houses or homes of the termite, are found in most altitudes, from the swamp to the mountain, and are not always located with regard to the convenience of the object to be attacked. An example of this was encountered in the military reservation at Zamboanga where the termitarium was located on the south bank of Santa Maria Canal. A trail of the termites was traced to, and leading under, the canal (which is about 4 meters wide and 1 meter deep), across the parade ground to a tree some 80 meters north of the canal. From the tree it was traced across the parade ground in a southeasterly direction, again passing under the canal, and terminating in a house on the south side of the canal.

A white ant queen. (Philippine Islands.)

In the construction of their homes preference seems to be for the earth, generally around or very near a bush, tree, or post, although many nests have been found inside of columns, and occasionally one where the end of a floor beam has been eaten away leaving only the nails embedded in a honeycomb composed of a tough, woody substance. These termitaria are of various sizes, ranging from a small honeycomb around a piece of wood to large mounds of earth, some in equatorial Africa reaching to a height of 7.5 meters and terminating in a sharp point.

In parts of Australia there is also found the "meridian" termite, the mounds of which have somewhat the shape of a tombstone. The term "meridian" is explained by the fact that the mounds all have the same orientation, the wider face of the structure always extending north to south. A termitarium, on being opened, displays a vast number of irregular chambers separated by their partitions and connected by small canals. The royal cell is usually near the center of the mound and is made of very tough clay mixed with termite refuse, but shows no evidence of wood. The honeycombs, on the other hand, are largely composed of woody fiber, the refuse proceeding from the alimentary canals of the insects being used for this purpose. Where the nests are in the ground near a house, the termites usually pass from their termitarium to a post by underground canals, entering the post below the ground surface, which makes it very difficult to detect their presence in these houses.



Formerly a yacal log, now converted into worthless pulp by anay (white ants or termites). Sample from Bureau of Supply sawmill, Manila.

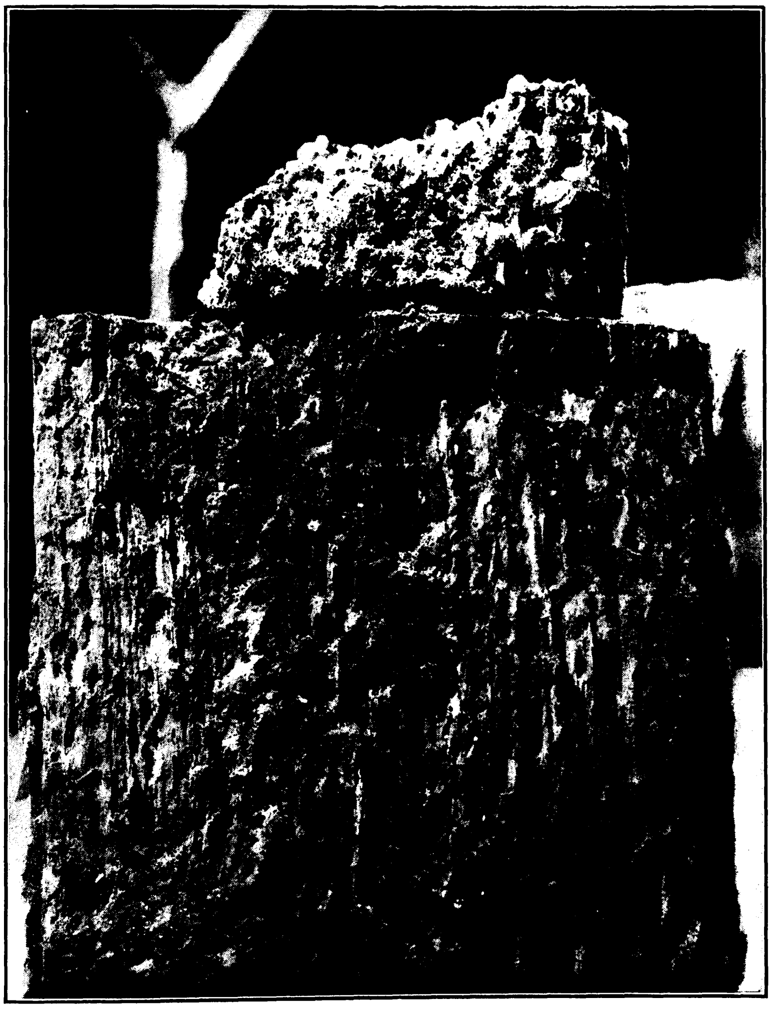
If the posts are of hardwood, however, they will often crawl up the outside till they reach some softer board to make their entrance.

Termitidae; living wood of cacao attacked by white ants. (Philippine Islands.)

Work of white ants in the wall of Mr. Seale's room, Bureau of Science, Manila.

While the Philippine woods, as a whole, generally resist the termite in proportion to their hardness, there are certain other factors which increase their resistance, the chief one being resin or gum; consequently the woods cannot well be classified according to quality or group. The following list furnished by a forester shows the various Philippine woods in their order of resistance to the termites; it should be understood that this list is only tentative, as the tests so far conducted have not been exhaustive enough to fix absolutely the order of resistance of these woods and later and more complete investigations may cause changes in their relative position:

Resistance No.	Name of wood.	Group.	Whether sap wood should be removed or not.	Resistance No.	Name of wood.	Group.	Whether sap wood should be removed or not.
1	Mancono	First	No.	26	Tucang-calao	Second	Yes.
2	Molave	do	No.	27	Balitong	Fourth	Yes.
3	Teak		No.	28	Bitaog (Palo Maria d. 1. Playa)	Second	No.
4	Narra	First	Yes.	29	Bancal	Fourth	Yes.
5	Ipil	do	Yes.	30	Calingag	do	No.
6	Sasalit	Fourth	No.	31	Calantas	Second	Yes.
7	Dungon	Second	Yes.	32	Acleng-parang	Fourth	Yes.
8	Aranga	do	No.	33	Liusin	do	No.
9	Yacal	First	Yes.	34	Guisocguisoc	First	Yes.
10	Macaasim	Second	Yes.	35	Kamatog	Fourth	Yes.
11	Betis	First	No.	36	Nato	Third	Yes.
12	Pagatpat	Fourth	Yes.	37	Tabigi	Fourth	No.
13	Calamansanay	Second	Yes.	38	Oak	do	No.
14	Acle	First	Yes.	39	Batino	Third	No.
15	Tindalo	do	Yes.	40	Baticulin	First	No.
16	Agoho	Third	No.	41	Balacat	Fourth	No.
17	Alupag	Second	No.	42	Marang	do	No.
18	Anubing	Third	Yes.	43	Mambog	do	Yes.
19	Banaba	Second	Yes.	44	Pusopuso	do	Yes.
20	Bansalaguin	do	No.	45	Lanete	First	No.
21	Batitinan	do	Yes.	46	Santol	Third	Yes.
22	Dugcatan	Fourth	Yes.	47	Malasantol	Fourth	Yes.
23	Malacadios	Second	No.	48	Lumbayao	do	No.
24	Malatumbaga	Fourth	Yes.				
25	Tabao	do	No.				

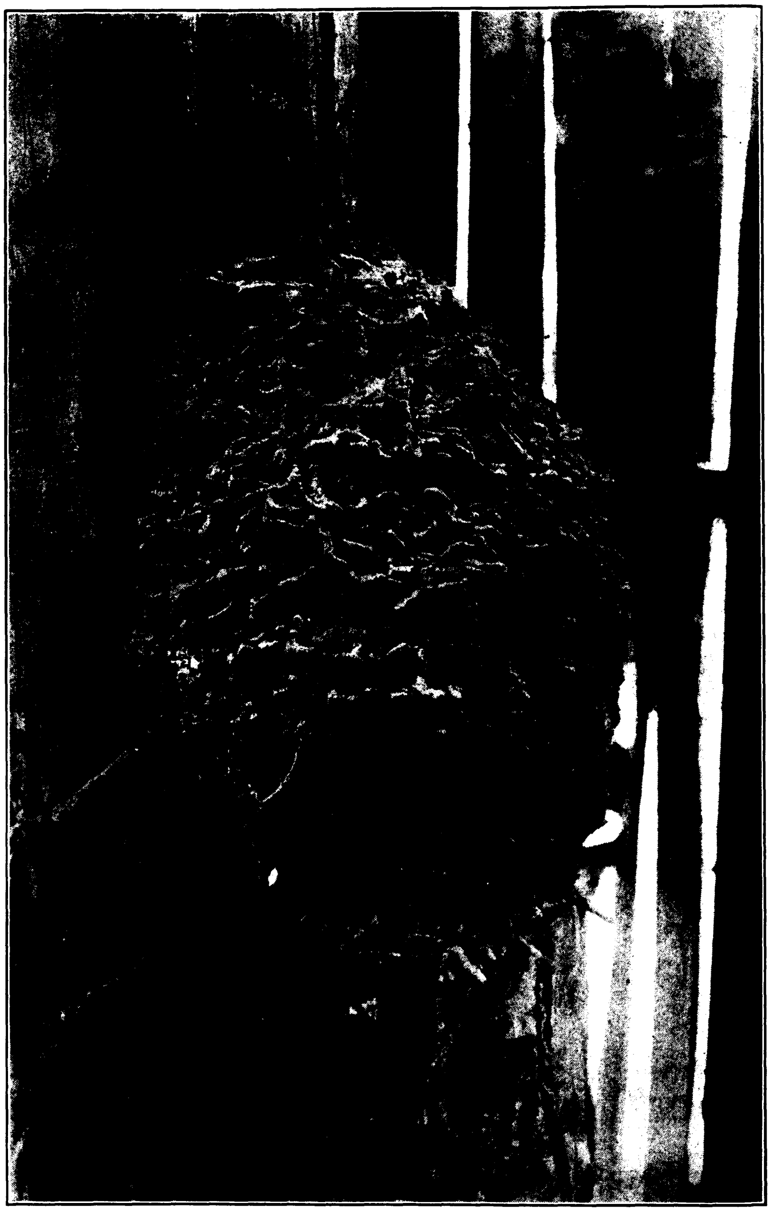


The action of anay (white ants or termites) on wooden posts and walling (Oregon pine); sample from Nozaleda yard, Manila.

Some of these woods resist the termite better than others, according to the circumstances under which they are used.

There appears to be only one effective way of preventing termites from entering an ordinary wooden structure. The supporting column should rest on a concrete pillar extending from 30 to 50 centimeters above the ground (fastened by drift bolts, iron straps, or other devices), and these columns should be treated with some tar preparation before being set in place. This can best be accomplished by soaking the lower end of the post or column in the hot solution for at least one day. Many of the coal-tar preparations are more or less effective in the prevention and resistance of termites, carbolineum being more extensively used than any other in the Philippines. Such pieces should be at least partially seasoned before treating, to admit of penetration of preservative into checks, knots, etc.

The extermination of termites can best be accomplished through the medium of poisonous gases. Possibly the simplest method is the use of commercial carbon disulphide, which can only be used on nests in the ground. The top of the mound is removed, and the main canal is located. Into this is poured from 425 to 850 grams of the solution (according to the size of termitarium), which immediately forms a heavy gas descending through the various canals, which are all connected, suffocating everything that has animal life.



The nest of a colony of anay (termites) under house of Mr. Harrison, district engineer, Bulacan, Bulacan Province, March 4, 1915.

In Cuba the natives were successful in attacking these termites by distributing powdered arsenic in the connecting canals or runways. The theory was that the termite would eat this powder, which, in poisoning him, would create a passion for fighting. Thus he would attack each ant encountered in his travels, thereby disseminating the poison broadcast. Probably what really happened was that the arsenic and its fumes forced them out of the structure elsewhere.

The most thorough and effective method of exterminating termites is accomplished with the "Ameisentoedter Universal" or ant-killing machine, which consists of a stove and force pump with rubber tube and pipe connections, manufactured in Uruguay, South America. The machine is connected up with the infected post or mound and one tablespoonful of poisonous powder is poured into the stove over burning charcoal, producing a smoke containing carbon disulphide gas and some extra sulphur dioxide, both of which are forced into one of the main canals under such pressure as to cause it to reach the utmost recesses. It ordinarily takes about thirty minutes to completely suffocate every insect with which the gas comes in contact, and although some of the termites crawl out of their canals, they are usually found dead near by, as they do not appear to be able to overcome the poisonous gas. It is not definitely known just how long one treatment will rid a structure of these pests, but houses that were treated some six months ago do not show any signs of being infected now.

Sectional view of a part of white ant's nest. (Philippine Islands.)

White ant's nest. (Philippine Islands.)

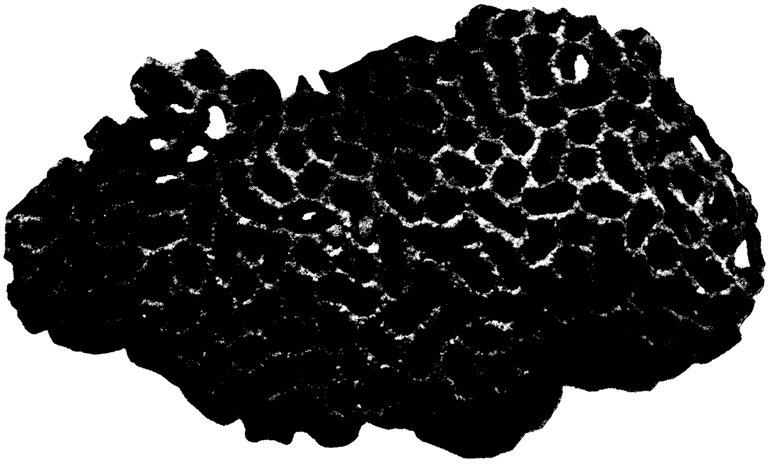
Fungus galleries of anay. (Philippine Islands.)

In most buildings it is necessary to make one application of this smoke to each 9 square meters of floor space, provided the whole structure is affected.

Two men are required for carrying on the work—one to operate the machine and the other to stop leaks in canals, trace the canals, and to locate the nest eventually by following the smoke. Unless the nest can be located and the whole colony exterminated at one swoop, it is believed that no satisfactory permanent results can be accomplished. It requires patience, intelligence, and application to start in on one infected post and to trace the paths of these termites to the nest often two or three hundred meters distant.

The quartermaster department of the United States Army has been extremely successful in this work and has developed some very clever operators of the machine outfit described above.

The Insular Purchasing Agent has a price of ₱36.75 for the furnace and pump, and ₱2.10 a tin (a kilogram) for the powder. The United States Army uses a different preparation with the same name that is cheaper in cost and apparently as effective in operation as that sold by the Insular Purchasing Agent.



Termitidae; brood cells of white ants, top view. (Philippine Islands.)

The operation for the small amount of work accomplished on public buildings at Zamboanga shows varying costs from ₱0.35 to ₱0.65 per 9 square meters of floor surface treated, dependent upon the degree of infection by termites that the buildings contained.

ILOILO PROVINCE.

By R. V. Glen, District Engineer.

The Province of Iloilo is about 170 kilometers long, 60 kilometers wide, and lies south of a continuous range of mountains running from the extreme southwestern point of the Island of Panay to the extreme northeastern corner. North and west of this range lie the Provinces of Capiz and Antique, respectively.

Iloilo comprises a little over 2,000 square miles, nearly one-half of the area of Panay Island, and is practically one immense valley, especially adopted for the raising of sugar, palay, and tobacco. There are, in all, 22 municipalities, the total population being about 500,000.

Dividing the province practically in two halves, the Philippine Railway runs north and south from the city of Iloilo to Capiz, creating a main outlet for traffic, fed by various first-class roads of the province which touch or cross it at most of the stations along the line.

This comprehensive system of transportation, together with the port facilities at Iloilo, makes of the Province of Iloilo the most attractive agricultural locality in the Philippine Islands. Appreciation of these conditions is just beginning to make itself evident. The traffic reports at the present writing indicate a substantial increase in the local production of all staple articles.

An interesting table giving the quantity and value of various commodities shipped over the Philippine Railway from 1910 to 1914, inclusive, follows. It indicates clearly the value of the so-called feeder roads constructed by the Bureau.

	1910		1911		1912	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
Rice	935	₱57,035	1,785	₱192,780	1,699	₱217,472
Palay	1,263	63,150	2,795	176,085	4,556	332,588
Corn	75	3,900	97	5,820	1,877	137,021
Hemp	128	32,720	105	25,500	193	61,760
Sugar	289	34,680	1,970	220,640	3,768	376,800
Tobacco	350	52,500	559	111,800	376	75,200
Total		243,985		732,325		1,200,841

	1913		1914	
	Tons.	Value.	Tons.	Value.
Rice	2,989	₱266,021	6,356	₱489,412
Palay	4,889	259,117	7,954	334,068
Corn	506	21,252	629	26,418
Hemp	175	102,200	172	82,560
Sugar	4,949	460,257	6,457	619,872
Tobacco	853	170,600	609	121,800
Total		1,279,447		1,674,130

The production of 1913 does not show a great increase over the production of 1912, but this is due to the severe typhoon in the latter part of 1912, and very severe drought during 1913.

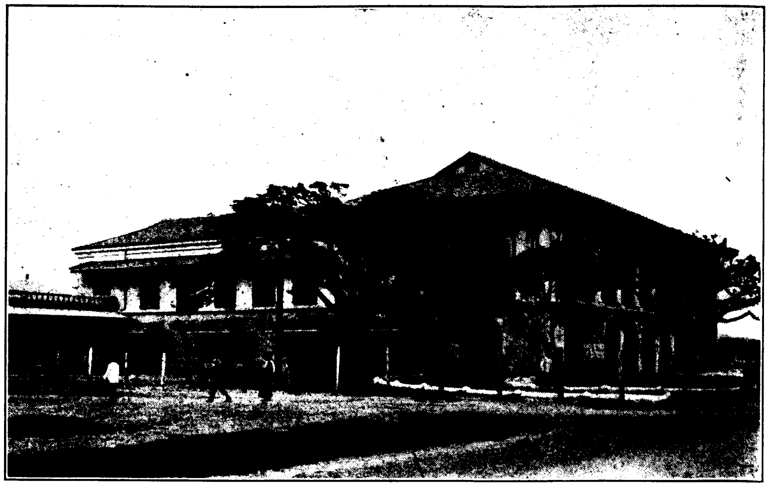
The decrease in tonnage of corn since 1912 must be attributed to the much larger consumption of corn at present by the native population, also to the general use in hog feed. The total amount of hogs shipped to Iloilo station from the interior amounted in 1912 to 720 head, and to 3,453 head in 1914.

Already sugar has taken a tremendous boom. The hacenderos realize that in the Iloilo Valley the best grades of sugar can be raised at a minimum cost and transported overland without depreciation. Final statistics on the sugar crop of 1914 have been practically completed and, although the planters suffered some loss on account of extreme dry weather, the year's crop is undoubtedly the largest ever taken off since the industry was started. In Negros and Panay it is estimated to be 3,200,000 piculs of 137½ pounds per picul. The previous record crop was in 1896 and amounted to 3,000,000 piculs.

At the present writing, the province has 162.3 kilometers of first-class road, all of which has been reconstructed or built entirely under the direction of the Bureau of Public Works.

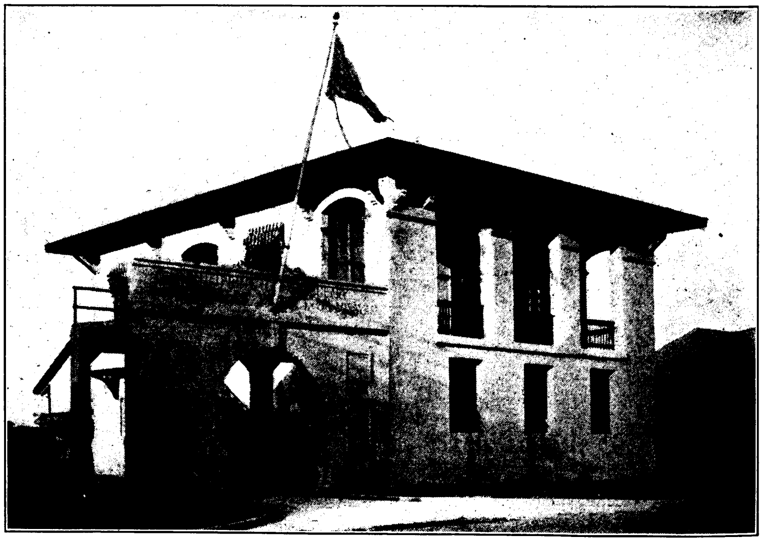
Starting from Iloilo and running in a southwesterly direction is the Iloilo–San Joaquin Road, 52.8 kilometers long, of which 21 kilometers are first class. This road, known locally as the coast road, runs through the municipalities of Molo, Arevalo, Oton, Tigbauan, Guimbal, Miagao, and San Joaquin.

In addition to numerous culverts and small openings, the Bureau of Public Works has constructed on this road four modern bridges, two of steel and two of the reinforced-concrete pile type, an example of which is shown in bridge 17.3, which consists of three 7-meter slab and girder spans. There are, however, some very interesting types of Spanish masonry, which are still in excellent condition. Especial attention is invited to the arch at kilometer 33. This work is faced with smooth geometrically cut stone, a coral limestone found in Igbaras. The effect is decidely mosaic in appearance and the work is beautifully finished. Further south, at kilometer 39, a curious old culvert with an opening of about 2 meters has two very elaborate approaches built on a curve, commemorating the work of Reverend Father Friar Francisco Perez in the year 1855.

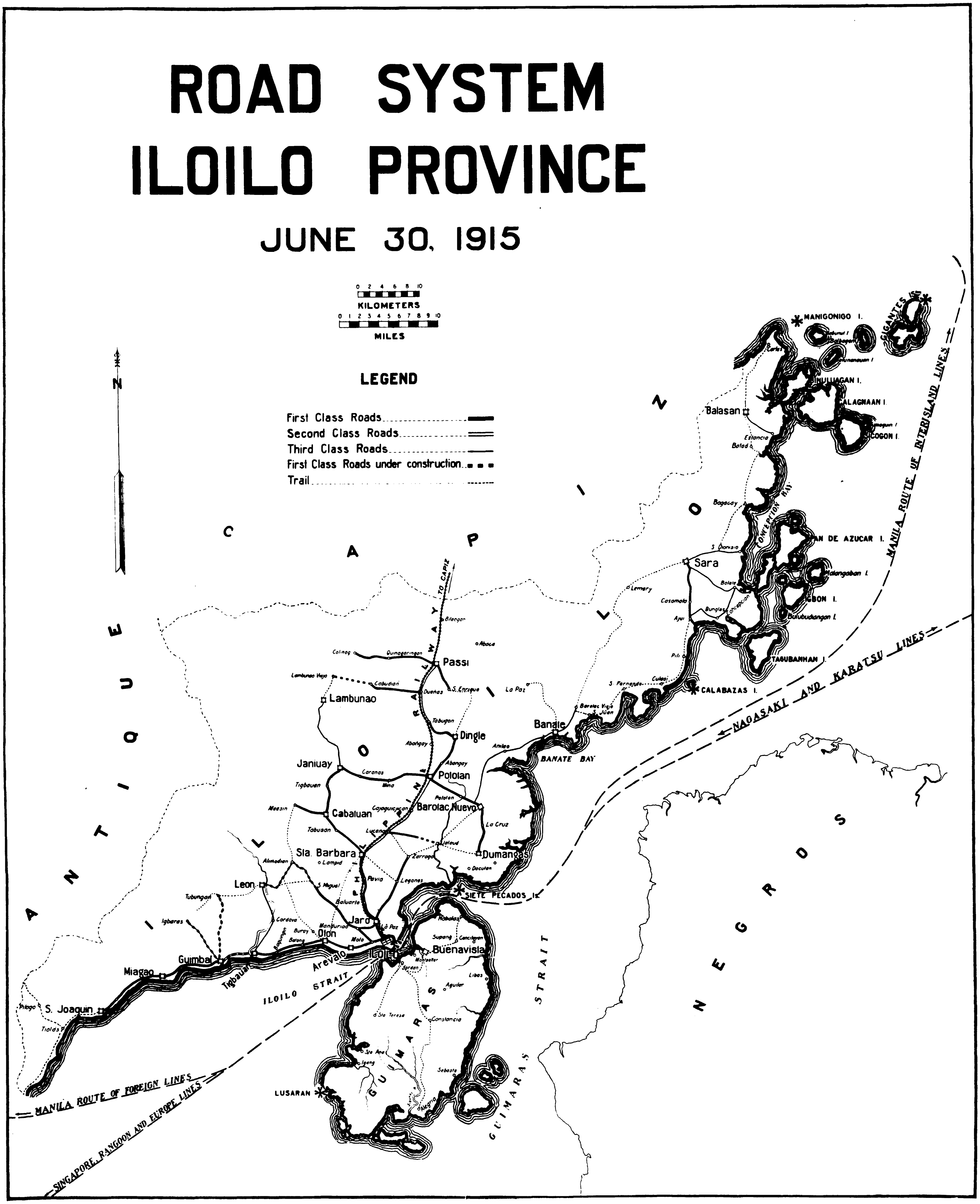


Provincial building, Iloilo.

Iloilo jail, completed 1912.



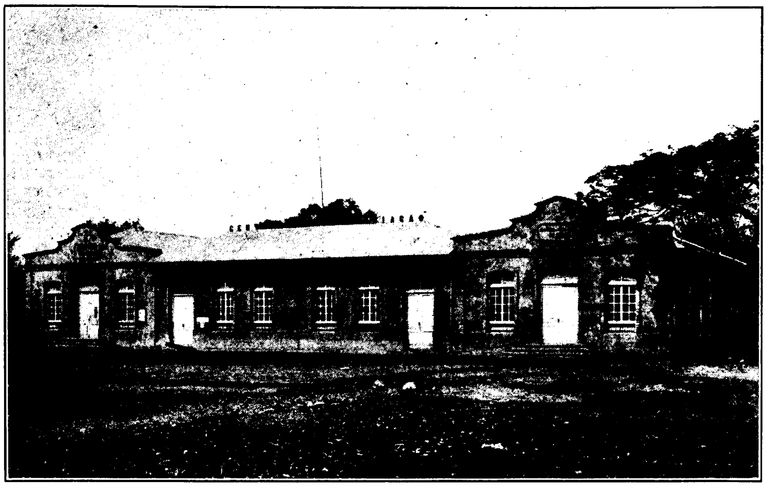
Constabulary headquarters, Iloilo. A similar building to be constructed to left of porte cochere.



ROAD SYSTEM ILOILO PROVINCE

JUNE 30, 1915

The church at Miagao, or rather what remains of it since its destruction during the insurrection, is a remarkable piece of masonry. The entire front is elaborately carved, representing various myths and legends. The entire structure, including the convent, was burned during the recent trouble.



Miagao School, Iloilo.

At Oton one of the first of the modern markets with tiendas was constructed in 1913. It is of the open-court type and has proven very satisfactory.

An excellent piece of work is the Molo market completed in March of the current year.

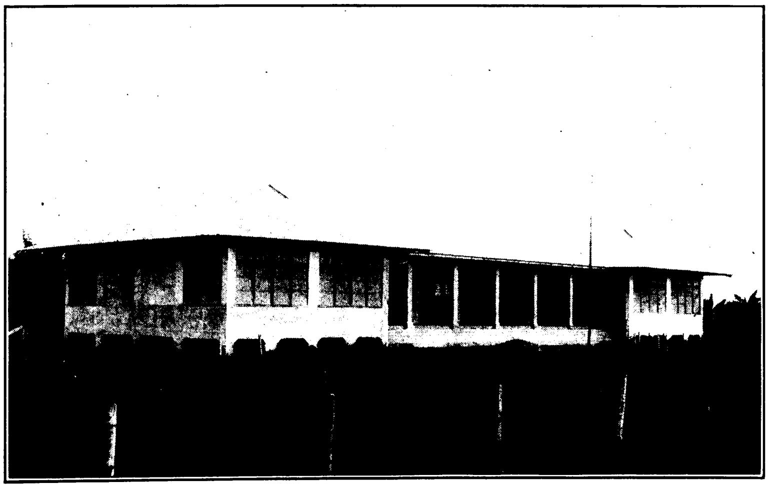
The most extensive piece of work, however, undertaken by the Bureau in the vicinity of Molo is the Carpenter Bridge, spanning the tidal estuary at kilometer 3.3 on the Molo–Jaro Road. This bridge was completed in 1911 at a cost of ₱93,871.37.

The Forbes Bridge, spanning the same stream at Iloilo, was built in 1909 at a cost of ₱112,438.25. Over these two bridges the bulk of all traffic from the interior passes to tide water.

At Jaro the Bureau in 1912 constructed a steel bridge of two 130-foot spans over the Jaro River, opening up the sugar district as far as Zarraga, 17 kilometers from Iloilo. The road is first class and heavily traveled.

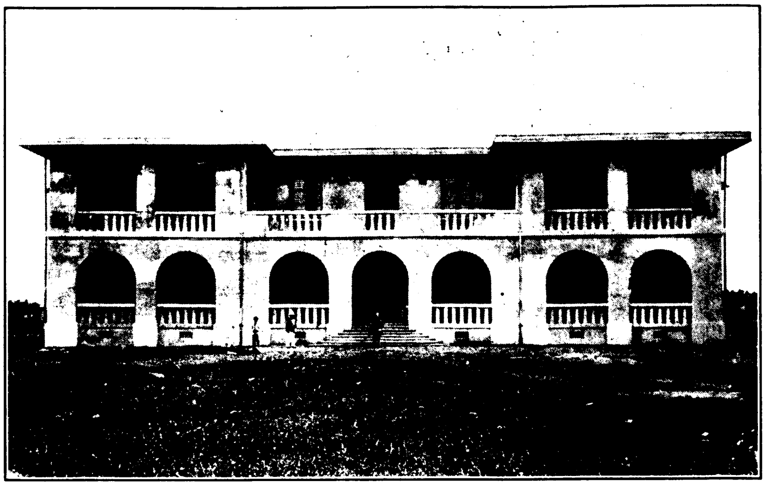
At Jaro, also, the Bureau has constructed two large market buildings with tiendas. This is one of the largest markets in the province.

A rather unique example of Spanish architecture is the old bell tower, or Campanile, in the plaza at Jaro.



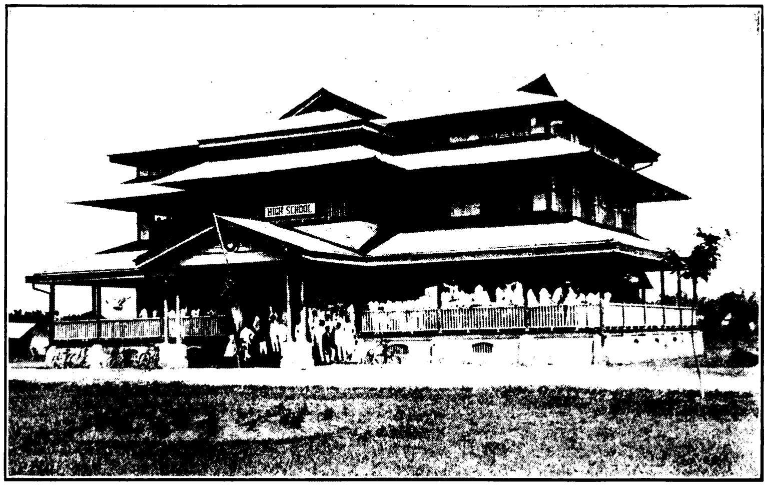
Santa Barbara School, type No. 7, Iloilo.

From Jaro north through the municipalities of Pavia, Santa Barbara, Cabatuan, Janiuay, Pototan, Barotac Nuevo, and Dumangas, the most continuous stretch of first-class road threads its way through a beautiful section of the valley. The distance from Iloilo to Dumangas is 65 kilometers. The most notable structure on this road is the Pavia Bridge, two 30-meter arches of reinforced concrete constructed in 1909.



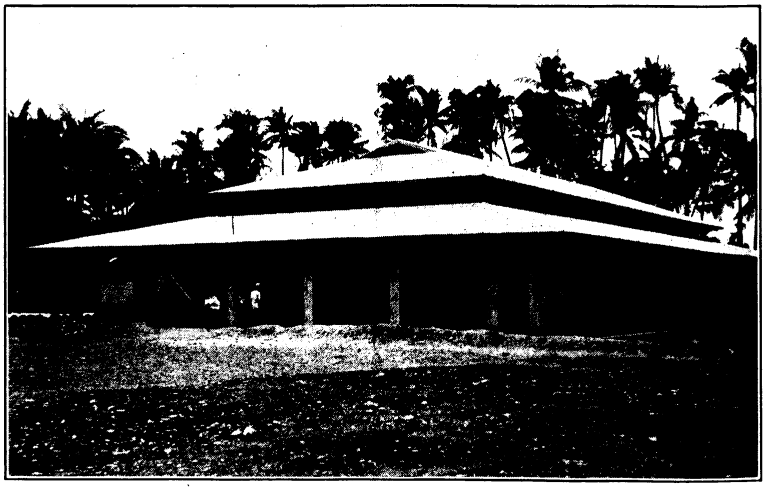
Dormitory at High School, Iloilo.

Santa Barbara is operating a very successful market constructed in 1913 and plans are completed for one at Cabatuan and one at Janiuay. Santa Barbara also boasts the first No. 7 school constructed in the province. This was built in 1913, by administration, at a cost of about ₱15,000.

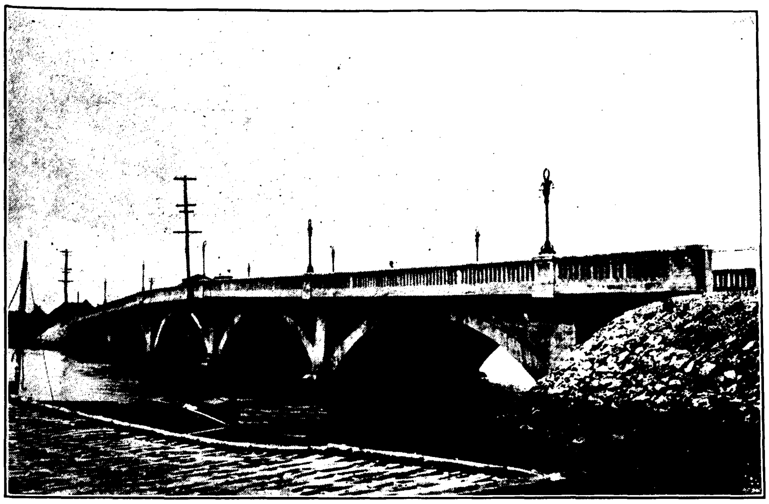


High School, Iloilo.

Probably one of the most curious structures in the Philippine Islands is the cemetery at Janiuay, a picture of which is shown.



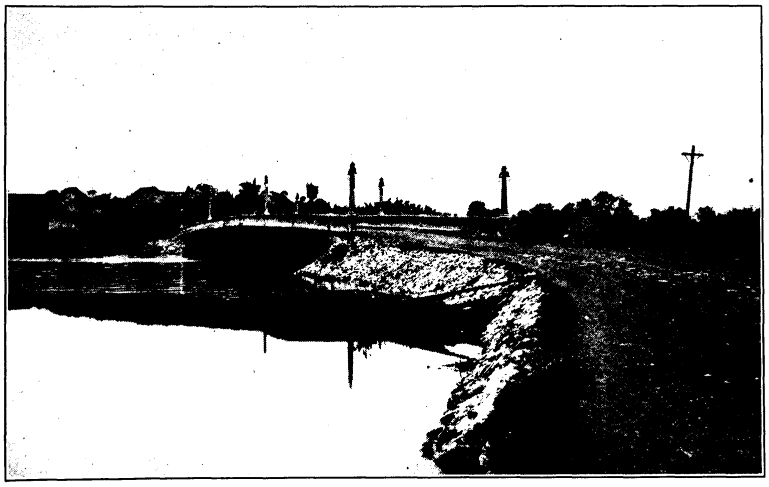
Molo market, Iloilo.



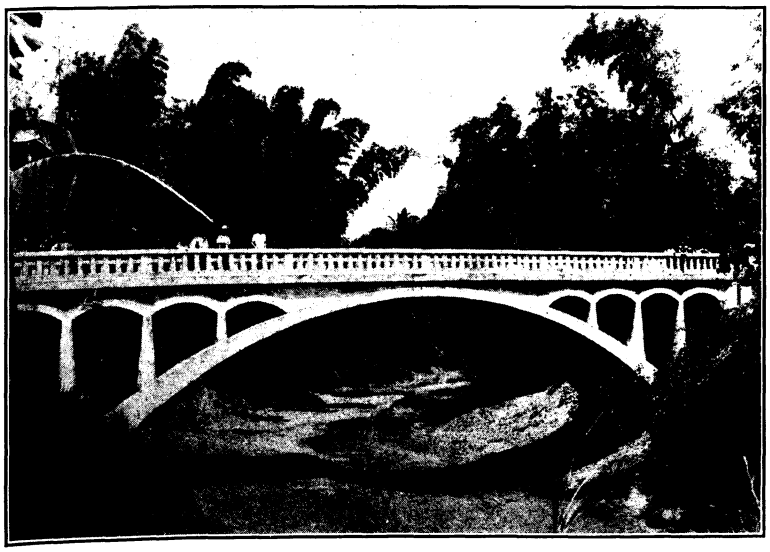
Forbes Bridge, Iloilo.

Three elaborate flights of stairway lead to the main entrance, the approach to which is highly ornamented with carved figures.

At Pototan, the largest municipality on the railway, the Bureau has constructed both a municipal building and a large modern market of the B type. Tiendas followed the latter, and it will be but a short time before an additional market will be necessary. A large 20-room school is also planned for Pototan in the near future, most of the money for which is already available.

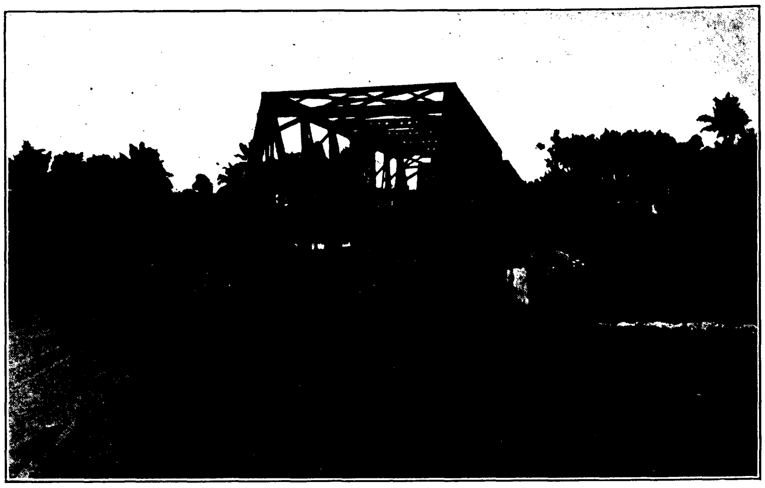


Carpenter Bridge, Molo, Iloilo.



Abangay Bridge, Pototan-Dingle Road, Iloilo.

At Barotac Nuevo a market building of the A type was completed this year, while at Dumangas a very attractive municipal building designed by the Consulting Architect is just being finished.



Steel Bridge, Jaro-Zarraga Road, Iloilo.

From Pototan to Dingle the second-class road is being reconstructed. From Dingle to Tabugon, a station farther north on the railroad, a first-class road of 5 kilometers was built in 1912. When the former is completed, an additional stretch of 13 kilometers will be added to the continuous road system in the province. At kilometer 3 on this road, a 22-meter reinforced-concrete spandrel arch was constructed in 1913 over the Abangay River. At Dingle ground has been broken for a new No. 7 school and a large market is planned for the immediate future.

The barrio of Tabugon has also planned for a new market.

Just south of Pototan at Lucena on the Philippine Railway, the Bureau has under construction a new road, 8 kilometers in length, to the Jalaur River. The entire road is graded and the first 4 kilometers surfaced. This road opens up an entirely new section of the province as does also the new road from Dueñas to Lambunao Viejo just north of Pototan. The latter, when completed, will be 17 kilometers in length. Both of these roads are being built under Insular allotments.

Pavia Bridge, Iloilo.

Immediately north of Dueñas, the province has 18 kilometers of first-class road, 13 running west from Passi to Calinog and 5 east to San Enrique.

A 6-room school was constructed in Passi in 1913 and a large market has been planned in the vicinity of the railroad station.

Probably nowhere in the Philippine Islands is there a more fertile and beautiful sugar valley than that through which runs the Sara-Ajuy Road in the northeast corner of the province. The road is 10 kilometers in length, built of broken stone in 1908 and 1909.

The only outlet is by water from Ajuy. Isolated as it is, however, the valley is very prosperous, there being some half dozen large haciendas on which practically nothing but sugar is produced. Still farther north work has been started on two schoolhouses, one of type No. 3 at Estancia, and one of type No. 6 at Balasan, some 8 kilometers in the interior. In 1912, under the direction of the Bureau, all culverts and bridges were constructed on the Estancia-Balasan Road, money for the reconstruction of which has been arranged.

Inlaid stone in approach to kilometer 33 on Iloilo-San Joaquin Road, Iloilo.

Estancia, while a small place and of minor importance during six months in the year, is noted for its immense fish market during the northeast monsoon.

The writer has been informed that at times the daily sales during the season have reached the remarkable sum of ₱30,000. The only outlet to Iloilo is by water.

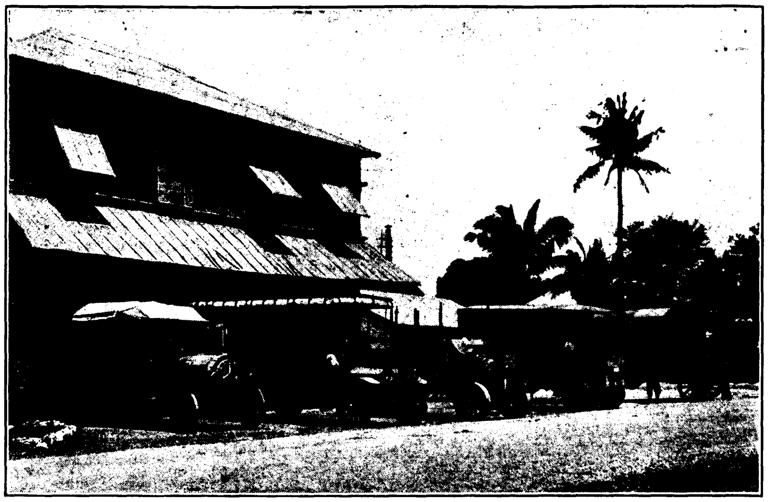
At kilometer 9.8 on the Manduriao-San Miguel Road, a 15-meter arch was constructed in 1913. This road extends 17 kilometers in a northwesterly direction from Iloilo and was reconstructed in 1911. An extension of same to Alimodian and Leon is now under way.

Kilometer 1-2, Iloilo-Santa Barbara Road, Iloilo.

The reconstruction of the provincial building was undertaken in 1908. The old building of adobe and hardwood was formerly occupied as an official residence during the Spanish régime.

Only the old walls were utilized under the approved plans. An entire story of reinforced concrete was added and several additions made to the lower. A tile roof covers the structure. The six large columns placed in front set off the building wonderfully and its general appearance from Calle Izmart is very handsome.

In the rear of the provincial building, the province constructed in 1911 and 1912 a new jail at a cost of about ₱80,000. Just between the two is the provincial nursery, established in 1913, from which are taken all shrubs, plants, and trees used in beautifying the grounds of schools and municipalities throughout the province.

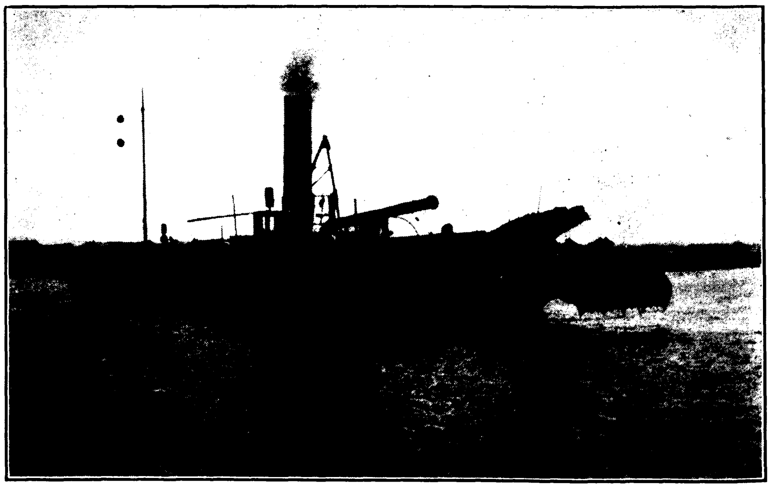


Panay auto line equipment, Iloilo.

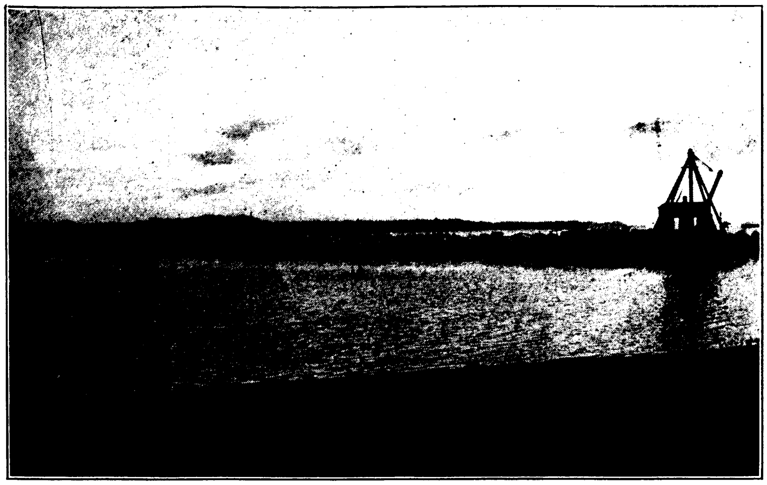
Iloilo is very fortunate in having immediately in the vicinity of the city a very attractive driveway or boulevard known locally as the "Loop," extending from Iloilo to Molo, to Manduriao, to Jaro, and return to Iloilo, a distance of about 10 kilometers of first-class road. On the road to Molo at Calle Mabini, the Bureau has just completed by administration a large 20-room schoolhouse for the Bureau of Education.

Just north of Calle Mabini and on the north side of Calle General Luna, the Bureau constructed in 1913 a 2-story concrete building for the Constabulary to be used as headquarters for the district of Visayas. Stables were also constructed, the grounds filled in, and a tennis court built.

At the southern extremity of Calle Antigua, leading from the Molo Plaza, the Bureau has undertaken this year, under an Insular allotment of ₱50,000, the construction of a jetty or breakwater for coast protection. This has been made necessary by damage caused through typhoons during the southwest monsoon. The jetty is being constructed of ton rock obtained from the Island of Guimaras. The work is nearly completed and has already demonstrated that it will more than justify its construction. A large sand bar is rapidly forming and reclamation of the land within it already begun.

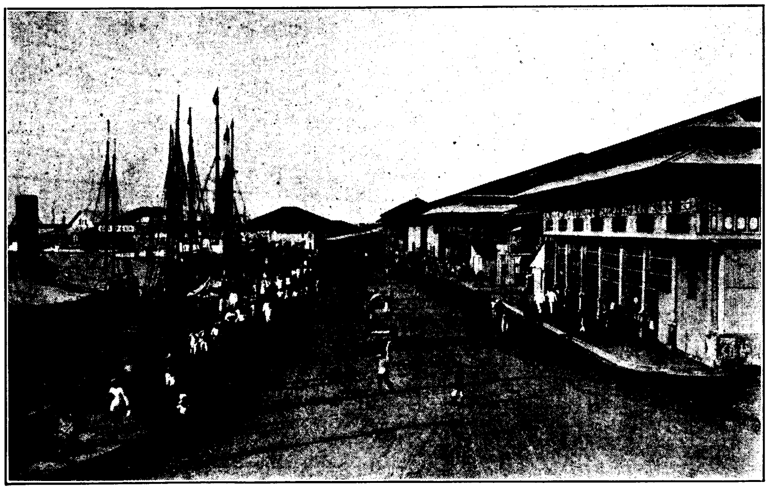


Dredging operations in Iloilo River, 1915.



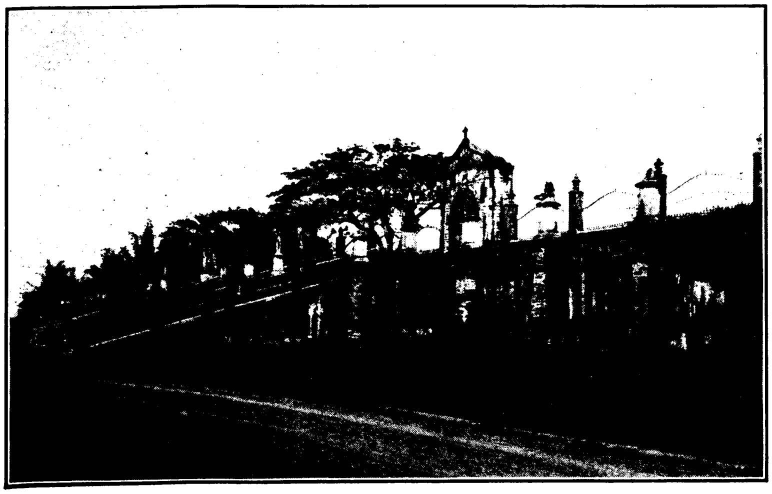
Portion of Molo jetty, Iloilo, at half tide.

The new customhouse is an assured fact; the detail plans are being prepared in the office of the Consulting Architect. Preliminary sketches, it is understood, have already been approved and it is hoped to begin construction not later than July 1. The new building is to go just west of the present quarters, the grounds are to be parked, and, if sufficient money is obtainable for the construction of a new river wall immediately fronting on the site of the new building, a vital necessity it seems to the general public, Iloilo can boast of a port service second to none in the Archipelago.

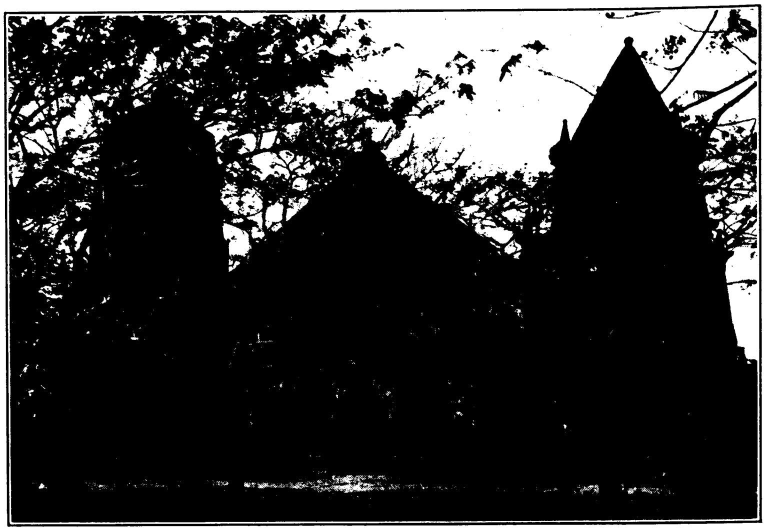


The Muelle, Iloilo.

Iloilo is apparently the only customs collection port which has not suffered a decrease in collection this year on acount of the war in Europe. For the first four months of 1915 the port collections amounted to ₱493,579.18, which is ₱86,562 greater than the first four months of 1914. This increase of collections is largely due to increased importations of rice, but there has been no let-up in importations of general merchandise.



Janiuay Cemetery, Iloilo.



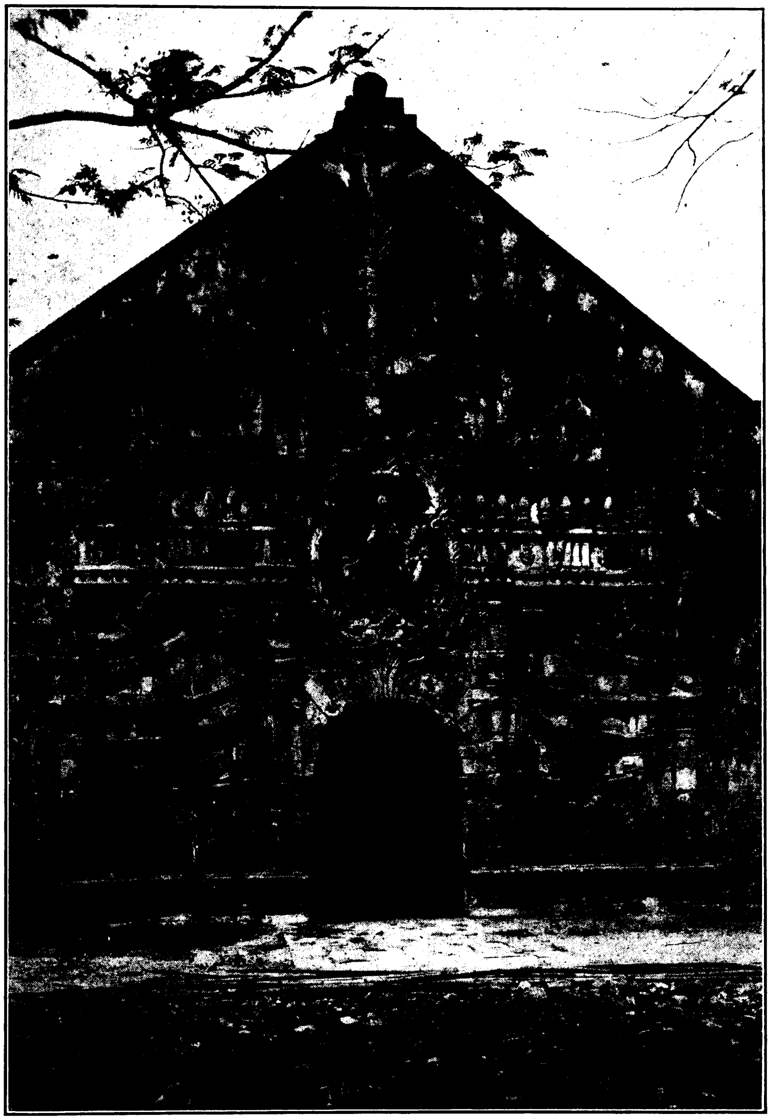
Church built of coral rock at Miagao, Iloilo.

Besides the regular coastwise steamer service, there are 147 two-masted lorchas, averaging about 40 tons gross measurement, operat-

Campanile at Jaro, Iloilo.

ing out of this port. The records show that the coastwise clearances of vessels at this port were greater than at both Manila and Cebu for the year 1914. Manila and Cebu, 5,116 clearances, Iloilo, 5,298. The entrances and clearances average over 47 per cent of the total entrances and clearances at the six customs collection ports of the Archipelago. The average carrying capacity of these lorchas is over 1,000 piculs of sugar. The entrances of coastwise vessels at this port for the first four months of 1915 is 444 greater than for the first four months of 1914.

The most interesting of all topics to residents of Iloilo at the present time, however, is the question of a water supply. This matter has been under investigation for several years. It was thought at first that it was possible and practicable to impound the waters of the Tigum River at a point some 4 kilometers west of Maasin, a distance of 31 kilometers from Iloilo. It was the intention to supply the municipalities of Santa Barbara, Pavia, Jaro, Molo, through which the pipe line would pass, and it was estimated that this additional demand would warrant the outlay of ₱1,500,000 necessary to install the plant. Surveys and estimates were prepared and a complete report forwarded to the Director of Public Works for consideration.



Carved facade of old church at Miagao, Iloilo.

In the meantime, it was discovered that several springs existed on the Island of Guimaras, just opposite the city of Iloilo, which would, if impounded, possibly furnish the necessary supply at a minimum cost. Weirs were constructed, surveys made, and it is hoped that by July 1 of the current year sufficient data will have been obtained to warrant an immediate interest in same on the part of the Insular Government.

All things considered, the Province of Iloilo has much to which to look forward, and if the work now planned throughout the province is carefully continued, a few years will see Iloilo foremost of the Visayan provinces.

ON THE JOB HERE AND THERE.

Mr. T. Warren Allen, formerly of this Bureau, is at present chief of National Park and Forest Reserve, Roads and Trails, Office of Public Roads, Department of Agriculture, and associated with him in charge of districts are the following ex-Philippine engineers:

A. E. Palen, formerly district engineer of Cavite, with headquarters at Denver, Colorado.

O. N. Powell, formerly engineer at Baguio and later district engineer of Ambos Camarines, with headquarters at Albuquerque, New Mexico.

C. H. Kendell, formerly Assistant Director of this Bureau under Mr. Beardsley, with headquarters at Ogden, Utah.

C. C. Morris, formerly district engineer of Cebu and later Bulacan, with headquarters at San Francisco, California.

S. V. Cortelyou is principal assistant engineer to the division engineer of the Los Angeles division, California Highway Commission.

W. H. Waugh is living at Riverside, California.

H. B. Kirkpatrick is located in Chicago with a Company which manufactures and erects coke ovens for extracting by products from coal.

W. F. Root is associated with the Cleveland Engineering Agency.

Hans Nusman, formerly assistant engineer of Leyte, and Clay Anderson, formerly with irrigation division of this Bureau, are with the California Highway Commission.

H. K. Davis, who will be remembered as district engineer of Pampanga and later of Oriental Negros, is now a representative of the Association of American Portland Cement Manufacturers and is in charge of a district composed of the States of Iowa, Minnesota, North Dakota, and South Dakota.

C. W. Keith, formerly bridge engineer of the Bureau, who has for some time been engaged on railway work in China with headquarters at Ichang, Hupeh Province, has severed his connection and returned to the United States.

PROJECT NOTES FROM DISTRICT ENGINEERS.

ALBAY.

A contract for the construction of bridge No. 42.1 on the Polangui–Libon Road has been let to Mr. M. E. Martin. This bridge consists of seven 9-meter reinforced-concrete deck girder spans on 12-meter reinforced-concrete piles. The contract price is ₱31,555.

A contract for the fabricated steel and field rivets for bridge No. 13.6 on the Guinobatan–Jovellar Road has been let to the Atlantic, Gulf and Pacific Company of Manila. This bridge is a 120-foot steel span. The contract price is ₱7,180, or ₱0.20 per kilo for 35,900 kilos. Construction of the abutments for this bridge will be begun by administration just as soon as steel and cement are received.

Construction by administration is in progress on bridge No. 12.7 on the Guinobatan–Jovellar Road. This bridge is a 10.5-meter span reinforced-concrete arch.

Grading was begun in May on the Guinobatan–Jovellar Road. On account of the large amount of grading necessary on this road and the limited funds available it is probable that no surfacing will be laid this year. This will give the heavy fills time to settle and at the same time will open up a greater portion to traffic.

Funds are available for constructing concrete tables in the markets of Legaspi, Daraga, and Oas.

Funds have recently been received and construction authorized for the following schools:

Rapu-Rapu, standard plan No. 3	₱7,162.89
Manito, standard plan No. 3	7,101.00
Calolbon (Catanduanes) standard plan No. 6	12,984.39

AMBOS CAMARINES.

Kilometers 1 to 4, inclusive, on the Daet–Mercedes Road have been surfaced, and the construction of the bridges and culverts is under way. Heavy rains and lack of laborers delayed the completion of this project.

The local agent at Daet disposed of 65 pairs of 3½-inch Bilibid cart wheels during the past three months and has outstanding orders for 30 pairs more. This seems to signify that the road will be used when completed.

One kilometer of road connecting the municipality of Cabusao with the barrio of Castillo was graded and surfaced.

Yacal tables are being installed in the recently completed type A, market building at Naga. This increases the renting space, makes a more sanitary market, and improves the appearance of the building in general. The site is being graded and drained by prison labor. The municipal council of Naga has solicited a loan of ₱16,000 for the construction of a row of ten double 4 by 6 meter tiendas, and if this is granted it will give Naga the best market plant in the province.

The Balos River Bridge at Iriga, a 150-foot steel span on reinforced-concrete abutments, was completed May 16 and formally inaugurated June 12, this being the principal event of the town "fiesta." This bridge connects Iriga with its principal barrios, giving a safe outlet for the production of one of the most fertile sections of Camarines Province. Funds available:

Municipal funds	₱5,000.00
Municipal loan	15,000.00
Special Insular allotment	10,000.00
	30,000.00
Cost of bridge and approaches	24,500.00
Balance	5,500.00

The above balance, in addition to ₱5,000 municipal appropriation, will be used to improve 10 kilometers of road connecting the barrios of Santo Niño, Salvacion, San Antonio, and Santiago to Iriga.

The following school buildings have been authorized to be constructed by administration. Iriga, No. 10; Salvacion, No. 2; and Pamplona, No. 4, all Bureau of Education standard plans.

The municipality of Buhi has appropriated ₱15,000 for the construction of a reinforced-concrete presidencia to be constructed according to standard Bureau of Public Works plan No. 741.

A loan of ₱150,000 was granted for the construction of the bridges and culverts on the Tigaon–Pili Road.

Grading was started on the Anayan section of the Tigaon–Pili Road on April 15. Four kilometers of the subgrade and five standard rectangular culverts are completed. Camps are constructed at convenient distances along the new road, subsistence being furnished the men by the province. Excellent work was done by the provincial officials in securing the right of way free.

Two 72-inch diameter by 22-foot American ingot culverts were installed on the Caramoan–Guijalo Road.

The Daet Central School Building, standard plan No. 7, is nearing completion.

A standard type B market, 21 by 43.5 meters, is under construction at Nabua.

ANTIQUE.

The construction of the San Jose–North Road is being pushed as rapidly as circumstances will permit. A handicap, due to lack of laborers, has been encountered. One cause of this has been due to irregularity of paying, and has been dealt with, as an experiment, by the appointment of a paymaster who pays the laborers weekly. Another cause of the lack of labor is that at the first heavy rain after the months of drought the people at once turned to their fields to plow and plant. However, subgrade work on the North Road is now on kilometer 29, 5 kilometers of surfacing being now spread and rolled, ready to be recommended first class. This will make the first-class road extend to kilometer 27, a total for the province of 52.5 kilometers.

The subgrade work on the South Road will be completed to kilometer 21, where it will be stopped for the present. After all the small temporary culverts between this point and kilometer 28 are completed, direct communication between San Jose and Dao, the southernmost municipality on this road, will be facilitated without the necessity of passing along the beach, which was the only route heretofore used. Gravel surfacing is spread as far as kilometer 17. A few figures on the cost of gravel on this road may be of interest. Six men at 40 centavos per day, working under a capataz at 50 centavos, can screen 6 cubic meters in one day, thus making the average cost per cubic meter ready to haul 48⅓ centavos. The gravel pit is about 1 kilometer from the road and the average haul is about 3.2 kilometers. Twenty men at 40 centavos and 1 capataz at 50 centavos per day can haul by tramway 18 cubic meters in one day. This makes 47 centavos per cubic meter in place ready to spread. This cost excludes the cost of depreciation of equipment, which consists of about 3,500 meters of rails, 6 tramcars, picks, shovels, and screens. The gravel is ordinary river gravel with average hardness.

The work on the Antique–Capiz Interprovincial Road is progressing very rapidly. Here again labor is one of the problems. The president of Pandan, Sr. Zaldivar, goes to every barrio and induces men to work, so that to his untiring efforts is due the success of the work on this road. Of the total of 7.7 kilometers from Pandan to the boundary, only 1.1 kilometers remain to be constructed. Work was started about the latter part of March of this year. The Antique side of the road is constructed with the approved cross section, having the full standard width, and the 15-meter right of way is at the same time claimed.

The construction of the Culasi School, standard Bureau of Education plan No. 7, was started about June 20. The contract price for the school complete is ₱14,365.85. The municipality gave the sand and gravel free and also promised to haul the materials from the landing to the school site. Mr. R. F. Adams of Iloilo is the contractor.

The cement for the Boñgol Bridge, also in Culasi, is already at hand. Other materials will arrive soon and construction will be in full swing about the early part of July. This bridge has four 9-meter reinforced-concrete deck girder spans on reinforced-concrete pile bents. Piles for the intermediate bents will be 9 meters long and those on the abutment bent 8 meters long. Total funds available for this project, ₱18,602.30.

Tree planting along the first-class roads is in full force, replacing dead trees which had perished during the hot season, and pruning those which have grown and are ready for pruning.

The question of adequate water supply is one to which the province has not as yet given serious attention. San Jose, the capital, has been no exception, but the council has lately requested a plan for a water-supply system. The financial condition of the treasury is such that a thorough investigation could not be made officially, but with the use of some spare time a survey was made, a plan is being prepared, and the cost will be estimated for a proposed water-supply system for San Jose with the hope of interesting public-spirited citizens in the project and, if possible, obtain aid from the right source.

Market day in Sibalom, Antique.

A tract of land has already been secured in Sibalom and the sum of ₱16,000 will be available for the construction of a standard modern market.

BATAAN.

Grading work on the Balanga–Orion Road has been brought up beyond kilometer 7, and surfacing was started from kilometer 5.8.

One and three-tenths kilometers of the Balanga–Puerto Rivas Road has been completed first class and opened to traffic. The rest of this road will probably be constructed next year.

About 2½ kilometers of the Orion–Limay Road has been converted from the trail to a second-class road, and with the installation of a wooden temporary structure across the Pandam River it is now possible for wheeled traffic to go nearly 3 kilometers beyond the town of Orion.

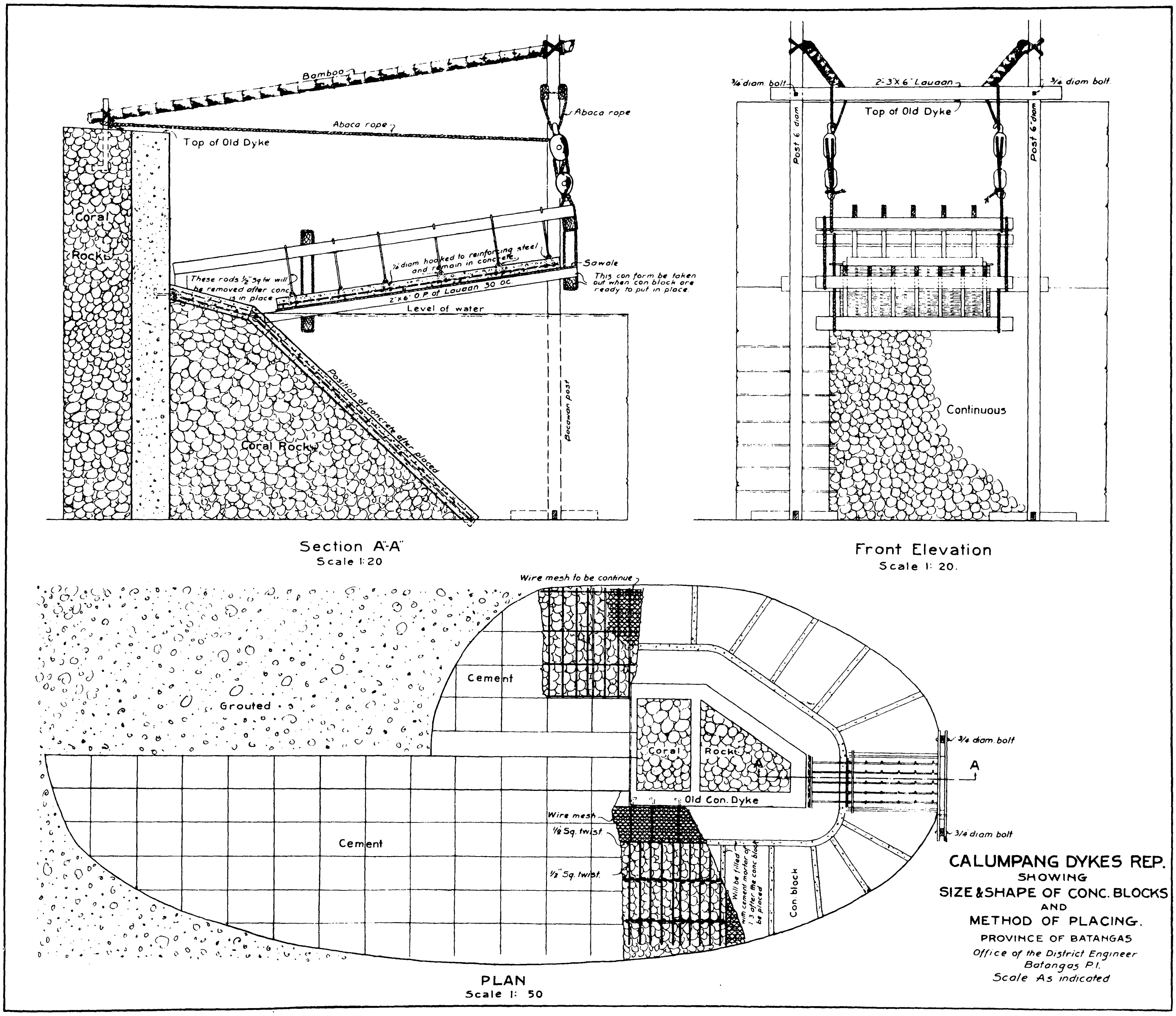
Request was made during the early part of June for the construction of an annex to the Provincial High School at Orani to accommodate more students. The appropriation has been approved and construction is now under way.

Expropriation of houses and lots for the Orani market site has been started and from the present outlook the market building is soon to be started.

Investigations and surveys for the Layac River Bridge and plans of the sites with all the required data are soon to be submitted, as it is contemplated to construct this bridge either the latter part of this year or early in the next.

BATANGAS.

The three road projects under way in this province, that were held up at the beginning of the quarter on account of lack of funds but were continued with funds from the regular allotment and a special allotment, have progressed nicely. Up to date there has been no rain to interfere with construction work. The Ibaan–Rosario Road has been completed to kilometer 124.5, about half way between Ibaan and Rosario, and Lemery–Calaca to approximately 1 kilometer west of the causeway. The Tuy–Nasugbú Road, west of Palico River, is all complete and the old road over the hills between Palico and Kaytitinga is now connected on either side with the new road around the hills.



CALUMPANG DYKES REP.
SHOWING
SIZE & SHAPE OF CONC. BLOCKS
AND
METHOD OF PLACING.
PROVINCE OF BATANGAS
Office of the District Engineer
Batangas P.I.
Scale As indicated

The Mataywanak and Kaytitinga Bridges were advertised during the past month. Two bids were received on each bridge, but as the lowest bids were 25 per cent higher than the estimate, all bids were rejected and the construction will be done by administration. These bridges, 15 and 18 meter arches, respectively, will be of adobe masonry substructure and concrete arch ring. Contract has been let for the steel for the Palico River Bridge.

Two substantial temporary bridges have been constructed over the washout sections of the Lemery causeway. It is probable that these bridges will have to be replaced with some permanent type of bridge later. As this is on the section affected by the Taal eruption, the best type of construction cannot be decided at present. This road settled about 7 feet for a distance of from 6 to 8 kilometers at the time of the eruption and it is still doubtful if the settlement has entirely stopped.

The Lemery presidencia has been completed and is now occupied by the municipal officials. The grounds around the building have been graded and are being laid off in concrete walks, etc. However, that type of building is so small that it does not come up to just what the municipal officials desire.

The Lemery market, a type B, 21 by 39.8 meters, is under construction, and, excepting the time held up for materials from the Bureau of Supply, work has progressed nicely.

Two blocks of 7 single 4 by 6 meter tiendas have been constructed by contract in the Batangas market. The contract was finished on May 14, contract price ₱7,600 per block. A 24 by 68.7 meter type

B market is being constructed by administration, work is progressing nicely, and it should be completed by July 30.

A 15 by 43 meter market is being constructed at Santo Tomas by administration. Material from the Bureau of Supply has just begun to arrive, the grading has been completed, and within a few weeks construction should be well under way.

Material has been ordered for schools at Bolbok and Banaybanay, Lipa, the former a plan 10, revised, and the latter a plan 2.

As a result of the good success of the Batangas water supply all the towns of the province are getting interested. Surveys and plans have been made for a similar plant in Lipa, and Cuenca proposes piping the water down from a mountain spring. Surveys have been made here, but the gaugings show the flow to be so small that it is doubtful if the supply will justify the expenditure.

Construction is under way for the Balayan water supply. The flow is from an artesian well with the well itself directly connected to the system. The pressure will not be sufficient to lift the water to the second story of any of the larger buildings.

The reconstruction and repair of the Calumpang dikes, authority for which was mentioned in the last bulletin, has been completed. Plans for the repairs were made in the Manila office and when they were received it was found to call for laying reinforced slab concrete under 4 meters of water with no possibility of shutting the water off. The part above water was laid in the 1 by 1.50 meter blocks according to plan without any difficulty, but when we began to place the concrete below water the difficulties came. Several methods were tried and failed; finally a method as per the attached sketch was used and worked very successfully. All concrete above water was first placed with the ½-inch reinforced bars extending a few inches below this concrete with a hook at end. After this concrete was sufficiently hard, rigging was placed as shown, the suali floor being supported by 2 by 6 inch timbers which timbers were supported by a 4 by 6 inch suspended from another support by 1-inch rope. This carried the entire weight of the block until it was sufficiently hard when the rope was taken off and all timbers below the concrete slab removed, the suali remaining under the slab when it was lowered into place. When this was done the slab was supported directly from above with the hooks cast into concrete as shown, then the entire block, various sizes, was lowered into place with the block and tackle and the ½-inch rods that formerly supported the block removed by divers. Between each block there was a joint of variable width which was filled with concrete by means of a trimme. Light posts bolted together with 3 by 6 inch timbers and braced with bamboo formed the scaffold on which all rigging was supported.

Two dikes were repaired for which we had an appropriation of ₱4,300. The work has been completed with a balance of ₱500.

BENGUET.

The Benguet Auto Line handled 1,741 first-class passengers, 1,198 third-class passengers, and 113,849 kilos of express and baggage during the period March 1 to May 31, 1915. Benguet Auto Line cars are still being operated over the Benguet Road and will continue to operate over this road during the rainy season if the road can be maintained from toll collections. The following is a statement of toll collections from traffic over the road, not including vehicles, etc., owned by the U. S. Army and Navy and Philippine Constabulary:

Receipts from—	
Bull carts	₱11,315.00
Pedestrians, at 10 and 5 centavos	1,473.05
Private autos	5,881.00
Autos (other bureaus)	256.00
Benguet Auto Line autos	1,098.00
Horses, cattle, and carabaos	337.10
Pigs, goats, sheep, and dogs	733.00
Vehicles (drawn by animals)	107.00
Benguet Auto Line passengers, baggage, freight, and express	4,512.89
Motorcycles	164.00
	25,877.04

A cable ferry has been installed at Camp Six over the Bued River, Benguet Road, capable of transporting a bull and cart or a small touring car, when the collapsible bridge is out, as shown in the accompanying views. Track cables are 1 inch and the hauling cable ⅝-inch; the span being 380 feet. The ferry is operated with a hand winch requiring four men for a load of 1,500 kilos.

Five gates have been installed on the Naguilian Road for controling traffic over this road since June 1, 1915. Seven gates will later be required for the control system when traffic over the road increases during the next dry season. Gates will be placed about 5 kilometers apart on the mountain section of the road.

A No. 4 Champion rock crusher, purchased from the Province of La Union, has been set up on the Naguilian Road for crushing rock for maintenance. It is proposed to surface practically the entire mountain section during the present year with a hard stone for a wearing surface available at three quarries along the road.

The hospital slide has remained practically dead for the past six months in spite of recent heavy rains. Judging from the action of similar slides in this locality, it is possible that this slide may not be active again for several years, although settlement has taken place at the rate of about 10 meters a year for the past three years. The question of transfering the Baguio Hospital building to another site is now in the hands of a committee appointed by the Secretary of the Interior.

The city of Baguio has awarded a contract to Mr. H. C. Heald of Baguio to supply firewood to meet the requirements of the city for a period of two years. Permission was also granted Mr. Heald to erect an aërial tram line over public land for transporting firewood and other forest products from Mount Santo Tomas to Baguio. The tram line passes about 100 feet from the Government Center pumping plant with terminus Military Cut-Off. The accompanying view shows a car being unloaded about 200 feet above the pumping plant.

Masonry culvert, Government Center, Baguio.

Experiments that have been made by the city engineer's office during the past two months in manufacturing brick in Baguio show that a good building brick can be made from clay available. Two brick market building will be constructed in the near future.

BOHOL.

Work on the Loay–Interior Road is making very good progress. The most difficult kilometer of the Loboc–Bilar section is now being constructed, so that an automobile can now reach kilometer 35, a distance of only 7 kilometers from Bilar. Six hundred men are working on this project daily and it is believed that within three months an auto can reach Bilar. The subgrade will have been almost finished by that time.

A rock crusher has been ordered for use on the Loay–Interior and Tagbilaran–North Roads. A good supply of rock suitable for crushing is available along the Loay–Interior Road and it is proposed to crush the rock where it is needed.

Concrete piles have been cast for the Anahauan Bridge between Tubigon and Inabanga. These will be driven in July. No other bridge work is now being done in Bohol except several small culverts in the neighborhood of Dauis, Guindulman, and Tubigon.

Five school projects are now pending. La Paz (standard plan No. 2), Loon (standard plan No. 7), Calape (standard plan No. 6), and Ubay (standard plan No. 7) school contracts were awarded to Messrs. Kipp & York of Cebu. They promise to complete them all in 180 days. The Mabini School will be built by administration, as volunteer materials are included in the amount to be furnished by the municipality.

Surfacing of the Tagbilaran–North Road near Loon is now being placed. Road to Candijay has just been completed and a third-class road to Cogtong has been put into good condition. The third-class road between Corella and Balilihan is also being repaired.

BULACAN.

The Bintog School, a 2-room standard Gabaldon building, is nearing completion.

The block of 16 tiendas for the Baliuag market is well under way. These tiendas would have been completed by this time had there not been some irregularity in the funds provided. In adjusting this matter, work was closed down for a period of some weeks but has now been resumed. The building should be completed early in July.

The foreman in charge of the construction of the Santa Maria School building, a standard 7-room Gabaldon school, reports that he will have the building roofed in about the 10th of July. The rate of progress on this building has been good, and unless there is some unexpected setback it should be completed early in August.

The work on the Pulilan–Calumpit Road is moving along as rapidly as could be expected. Some difficulty was experienced in obtaining the right of way for this road, as most of it is over an entirely new location; but the difficulties which came up were finally adjusted through the coöperation of the members of the honorable provincial board, and since the final adjustments were made construction work has progressed rapidly. By July 1 between 6 and 7 kilometers of new road were completed. This will make it possible to use the new route from Manila to San Fernando through the wet season.

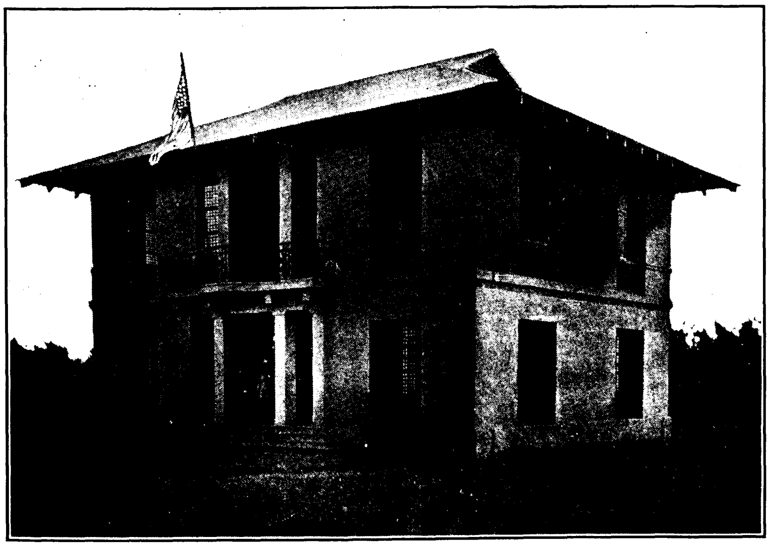
CAGAYAN.

A new era in the history of Cagayan Province was marked by the recent arrival of a 2-ton automobile truck. It is being operated over the finished section of the first-class road now being constructed between Tuguegarao and Alcala, and is receiving liberal patronage. As was to be expected, this has increased the public interest in the progress of the continuation of the road, which has now reached kilometer 28, an addition of 6 kilometers within the last six months.

The construction of the Babogan Bridge, on kilometer 24 of this road, was begun in June of this year, but not much progress has been made at this date, July 1, owing to a delay in the arrival of materials. The bridge is to be a reinforced-concrete structure with a total length of 74 meters—one 12-meter and eight 7-meter deck girder spans. The center span of 12 meters to be supported on piers and the other spans supported on concrete piles.

The steam dredge and snagboat *J. M. Dickinson* is now in operation constructing pile hurdles in the Cagayan River about 12 kilometers above the port of Aparri. At this point an island has been formed and neither channel has sufficient depth to accommodate the larger boats. An effort is being made to divert the water from the east channel, which is long and tortuous, into the more direct one to the west of the island, and judging from results already obtained, the effort will be successful. This will also be of great benefit to the town of Camalaniugan, situated on the east bank a few kilometers before the hurdles, by preventing a continuation of the erosion which threatens to endanger the town. This work is to be done from an appropriation of ₱15,000 by the Legislature and a special allotment of ₱20,000 by the Honorable the Secretary of Commerce and Police for the maintenance of Cagayan River.

During the year there will be about ₱25,000 spent in an effort to maintain the second and third class roads and to open up several trails to cart traffic. As was pointed out in the last issue of the BULLETIN, the success or failure of the undertaking depends largely on the coöperation of the municipalities through which these roads run.



Camalaniugan presidencia, Cagayan Province.

The Camalaniugan municipal building, a 2-story reinforced-concrete structure, has just been completed at a cost of approximately ₱14,500 and is now occupied by the municipal officials.

The Aparri customshouse, which was recently struck by lightning, is now undergoing repairs.

CAPIZ

Buruanga, on the northwest point of Panay, has always been isolated and difficult to reach overland from other points in this province. The trail from Navas to Buruanga, some 40 kilometers in length, has been opened and is now passable as a pack tail at all times.

The road-construction program for this year is nearing completion. The Panitan–Pilar Road is now surfaced to kilometer 33.7 and structures are completed to kilometer 35, while the road is open to vehicles to the Aranguel River, kilometer 37.5.

A contract has been let for delivering gravel on kilometers 23, 24, 25, and 26 of the Tangalan–Ibajay Road. This road will be first class from Calivo to kilometer 27 by October.

The old wooden bridges on the Capiz–Ivisan Road are being repaired or replaced. A ferry will also be installed. This work will open up an additional 16 kilometers of third-class road for wheel traffic.

A contract has been awarded for furnishing gravel for the resurfacing of the Calivo–New Washington Road from Calivo to kilometer 7. This road sustains the heaviest traffic in Capiz Province.

Much difficulty has been experienced in the past in maintaining the alignment between the surfacing and the shoulders on our first-class roads. Each caminero has had his own ideas of surface width and alignment. Recently the surveyman has gone over each and every kilometer with a transit and set wooden pegs flush with the ground every 30 meters on both edges of the metal. Camineros now trim the shoulder grass to the true lines. From an esthetic point of view alone, the results well repay the effort expended.

Materials have been requisitioned for 3-room school buildings for Ivisan and Pilar, respectively. Construction will begin on both projects as soon as the materials arrive.

The provincial board has authorized the purchase of a 36-foot launch with a 15-horsepower Meitz and Weiss oil engine. The launch will be used principally for passenger service between Capiz and New Washington, the port of the Aclan or western district. The increased facilities for communication between the two ends of the province should do much to break down the provincialism which exists and to create more intimate relations between Capiceño and Akeanon.

A modern rice mill is under construction at Dao on property leased from the Philippine Railway. Its capacity will be 500 cavanes per day. This project should prove a good stimulant to local business.

Tables have been constructed in the Capiz market according to standard plans as follows:

	Cost.	Unit cost.
12 linear meters meat tables	₱143.31	₱11.94
26.6 linear meters fish tables	342.75	12.89
60.6 linear meters vegetable tables	361.70	5.97
1 ticket booth	116.76	
Total	964.52	

The meat and fish tables are concrete throughout, with galvanized-iron pipe racks. The vegetable tables have concrete standards and yacal tops. The above costs are exclusive of surcharges.

Plans are in preparation by the Consulting Architect for market buildings at Dao, Pontevedra, New Washington, and Banga. These projects will be advertised in the near future and construction should begin soon.

The following bridge projects will be advertised during July:

No.	Road.	Type.	Span.
			Meters.
1.4	Capiz–Libas	Reinforced-concrete slab and girder on pile foundation.	10.0
27.9	Capiz–Dumarao at Dao	Collapsible wooden deck, 5 spans	30.5
35.6	Capiz–Dumarao at Cuartero	Collapsible wooden deck, 11 spans	67.1
30.4	Dao–Mambusao	Concrete arch, 20° skew, on pile foundation	22.0

The last three of these are within a radius of less than 4 kilometers.

CAVITE.

During the months of April, May, and June, 6.8 kilometers of second and third class road have been reconstructed and surfaced with broken stone and gravel.

The section from Zapote to Binakayan Ferry crossing is now completed first class; 3.2 kilometers were completed this year. This finishes a first-class road from Manila to Silang, a distance of just 50 kilometers. There were two railway approches and two bridge approaches on the old road which were on approximately 18 per cent grades. These have been reduced to 3 per cent in all four instances and the roadbed raised above extreme high water in all places. The full 15-meter right of way was secured throughout the entire length of road, including that part passing through the municipality of Bacoor.

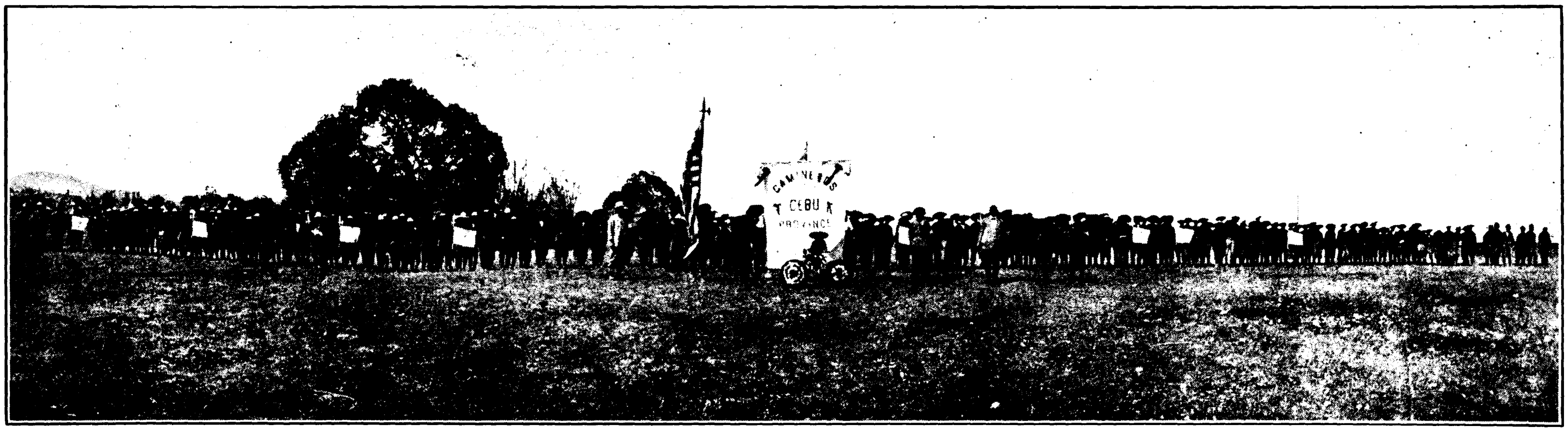
One kilometer, No. 37, of gravel-surfaced road was completed on the Malabon–Buena Vista route, together with four new concrete culverts. The full 15-meter right of way was secured here also. This leaves 4.5 kilometers of road to build before reaching Buena Vista.

One kilometer of new gravel-surfaced road, with three culverts, was completed on the route from Tanza (Santa Cruz) to Quintana.

On the Naic–Indang Road 1.4 kilometers have been surfaced with broken stone and approximately 2 kilometers of subgrade will be completed.

This makes a total of additional first-class roads actually reconstructed this season of 6.8 kilometers.

A large number of concrete culverts have been constructed to replace old Spanish adobe structures. Twenty-five in all have been replaced this year, and they total a clear span of 28 meters. This province has hundreds of adobe-stone arch culverts ranging in span from 50 centimeters to 5 meters. They are failing very fast now under the heavy traffic brought upon them by auto trucks and heavy carts. The plan is to replace as many each year as fail or seem to require new structures for safety.



Cebu camineros, ready for Cebu carnival parade.

Four new school-building projects are now under construction, all from standard plan No. 7 (40 by 14 meters), one in Silang and one in Tanza. For Indang and Alfonso the same plans are to be used, but adobe stone is being substituted for concrete on account of the great cost of hauling, over 28 kilometers of bad roads, materials for concrete. The stone can be secured near the building site and at such a price that the building can be completed for ₱12,500.

A plan No. 2 is now completed in the barrio of Bacao de Malabon. It has a concrete walk 1.5 meters wide leading to it from the street, and a good woven-steel wire fence around 1 hectare of ground.

All these projects, except Indang and Alfonso, are finished with concrete partitions and front walls, the only wood is in the roof framing and the floors, windows, and doors.

A plan No. 3 was finished in Dasmariñas with the same improvement as enumerated above.

Quite a fine scheme is now being worked up for a road to continue from Manila through Silang to the top of the big tableland above Taal Lake, thence to the right along the Cavite–Batangas boundary line to Caititiñga, when the road will turn slightly to the left and pass down a gently sloping ridge into Tuy, Batangas. This town is now connected by first-class roads with the Batangas system, this in turn being connected to Calamba, Laguna, and to the Manila–South Road system. The distance from Silang to the top of the plateau above Taal Lake is 11 kilometers. This is directly above the town of Talisay, Batangas, and is 2,230 feet higher. A wonderful view of Cavite, Laguna, Batangas, and Manila Bay can be seen from all along this big table land; one can see straight down into the crater of Taal, the elevation of the rim of the crater being about 1,000 feet above sea level. The surface of the lake is 9 feet above sea level and Talisay lies on the shores of the lake. The distance from the place where the proposed road will reach the top of the ridge to Caititiñga is 24 kilometers, following the edge above the lake for half the distance and over gently rolling hills covered with tigbao grass, corn, rice, sugar, and hemp. The whole tableland is very much like the plains in Wyoming and Montana. There is no timber, and the whole area, approximately 10 by 35 kilometers, or 350,000 hectares, is composed of the finest class of land. Most of it is taken up now and large areas are under actual cultivation. This road will be a great project for the development of the back part of Cavite Province. The towns of Amadeo, where the finest grade of hemp in the world is produced, Mendez-Nuñez, and Alfonso can be connected to this main road by side roads or feeders 6 kilometers to Amadeo, 6 kilometers to Mendez, and 8 kilometers to Alfonso. The ridges are such that no cuts of more than 2 meters will be required nor a grade to exceed 4 per cent. From Tuy to Caititiñga the distance is about 18 kilometers lying entirely in Batangas Province. To connect the main road from Silang to Tuy will require approximately 53 kilometers of comparatively light work. The plan is to secure broken stone around Lake Taal and lift it up the elevation of 2,200 feet by means of an aërial tramway. The estimated cost per kilometer of stone-surfaced road, including all culverts, is ₱10,000. The temperature on the ridge at night is always so low that blanket is required for comfort during the months of April, May, and June. A survey of the route is to be made during this year and it is proposed to secure sufficient funds to grade the 11 kilometers from Silang to the top of the ridge. Road rollers and other equipment can be taken to the point where stone is delivered by tramway and surfacing carried on from that place.

CEBU.

Maintenance repairs have been completed on the Southern Islands Hospital buildings, the Cebu customhouse, and the Constabulary buildings in the city of Cebu. The work consisted of roof repairs, including gutters and downspouts, plumbing, and repainting of parts of all the buildings. The wisdom of keeping these concrete buildings in first-class condition is evident. It is to be regretted that funds are not provided as promptly for repairs to the standard school buildings in the province, certain ones of which are badly in need of painting and minor repairs.

School building construction is about to be resumed. A standard plan No. 7 for the central barrio of Bantayan, in the Bantayan Islands off the north coast of Cebu Island, is being advertised. Bids are also requested for a plan No. 4 in Balamban, on the west coast, in Daanbantayan, the most northerly town in Cebu, and in San Francisco in the Camotes Islands.

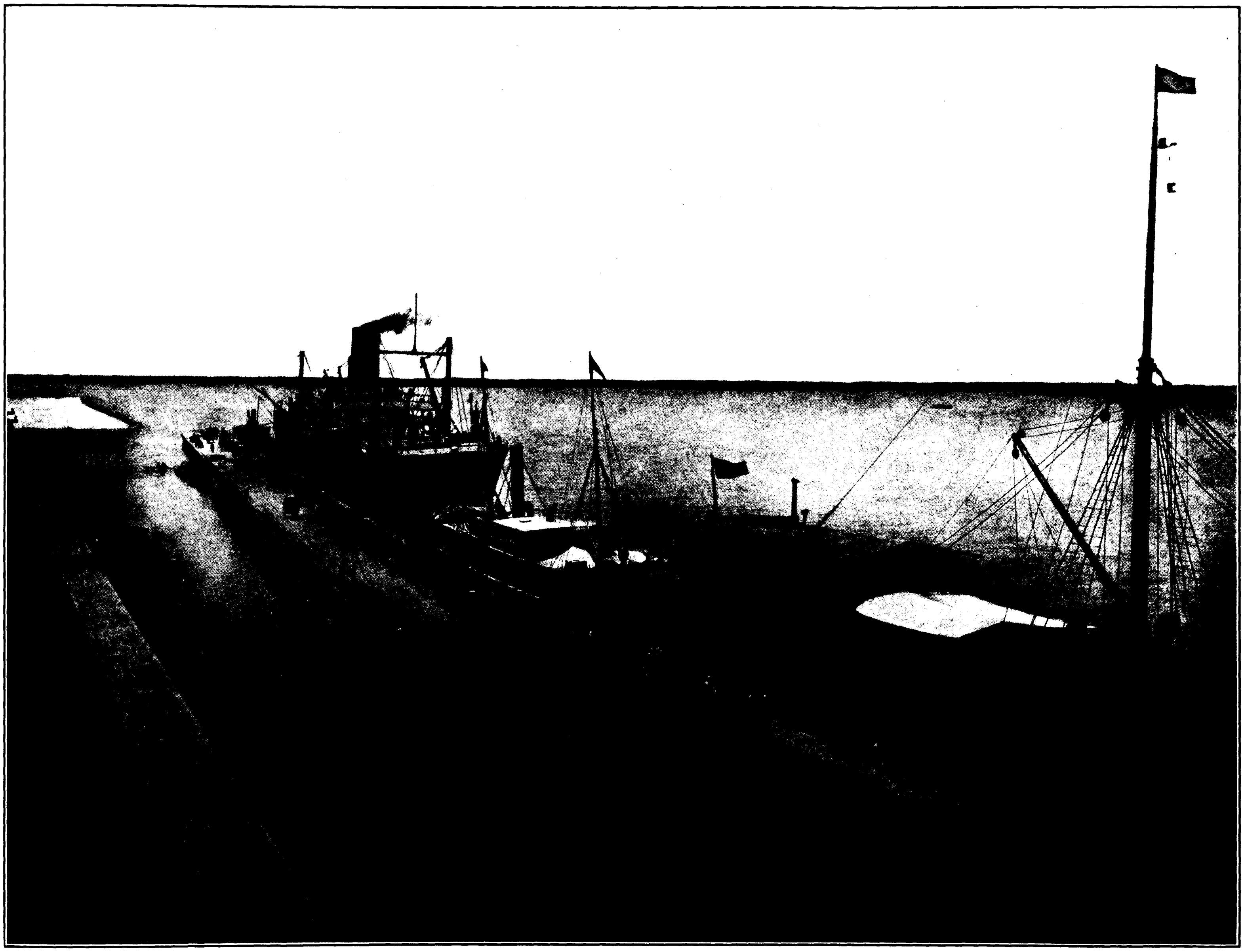
The dredging, back filling, and paving operations along the Cebu water front are proceeding rapidly. Dredging along the old wall from the Carbon Market to the angle is completed, and careful soundings have shown a uniform depth of over 18 feet. As much of the dredged material as can be loaded on the small scows is being used to make the fill behind the new wharf. It was found more economical to have the scows discharged by contract, either over the new wharf by baskets or wheelbarrows, or shoveled directly in place at high tide. The contract price per meter for discharging the smaller scows, neither of which are self-dumping, is 20 centavos a cubic meter. The dredged material so far placed in the back fill has consisted of about an equal number of scows of sand and mud.

Pavement construction is being expedited as much as possible before the rainy season sets in. Excavation is carried to subgrade, and a wooden templet used to give proper crown. Two-inch Danao crushed rock is then spread and rolled to a depth of 15 centimeters. On this, for a foundation, two layers of asphalt are spread separated by a

½-inch layer of screened blue river gravel and covered with a final layer of finer gravel. The layers of asphalt and gravel are rolled separately and sufficient asphalt is used to secure an effectual bond between the upper and lower coats. The finished street has a steel gray appearance very restful to the eye.

Construction work in the Cebu–North Road is progressing very well, about 400 men being employed. The funds now available should complete the subgrade to Bogo and place a light surfacing for most of the distance. The road in all is 104 kilometers long, of which 53 is first class, 28 second class, and 23 yet under construction.

The Cebu–Toledo Road surfacing will be finished by about August 1. This will make the road passable at all times from Cebu to the west coast. It is quite possible that a passenger truck will operate on this road in the near future.



Cebu wharf extension, looking east from top of customhouse.

The Barili–South and Argao–South Roads are well under way, the former will be completed to Moalbual by next month while the latter will reach kilometer 77, 12 kilometers south of Argao, before funds are exhausted.

Bids have been opened for the construction of the Sibonga waterworks system. The great rise in the price of galvanized materials will materially increase the cost of the system. The 3-inch pipe, formerly selling for ₱1.59 per linear meter, is now quoted at ₱2.60. Some 7,000 meters of this pipe are required in the construction of the delivery line and distribution system. In spite of this increase, it will be possible to construct efficient waterworks for the funds available.

ILOCOS NORTE.

The construction of Laoag market, with two blocks of double 4 by 6 meter tiendas, was completed on May 21, 1915. Twenty standard sales tables and one ticket booth for the market are being constructed and work is progressing fairly well. It is estimated that the tables and the booth will cost approximately ₱5,400, including some extra work, such as installation of wells and pumps, general improvement of the market grounds, etc.

The sales tables for Batac market are under construction. Delay on this work has been mainly due to waiting for materials from the Bureau of Supply.

The construction of Bacarra and Badoc markets will soon be under way. Materials for both buildings have already been requisitioned.

Work on the construction of Pasuquin School, plan No. 7, was suspended in March 31, 1915, due to failure of the municipality to furnish the necessary lumber for partitions. Work was resumed on May 9 and the building is now practically finished.

The construction of Laoag East Central School, plan No. 20, was completed on April 30, 1915, at a contract price of ₱36,000.

Work on the construction of Badoc School will soon commence. Materials for this school have been requisitioned from the Bureau of Supply.

A portion of the materials for concrete piles for the Laoag Spillway has now been received. Construction will start soon.

A diversion, 600 meters in length, of the upper Baruyen Hill Road has been completed and a maximum grade of 6 per cent has been effected. The old road had a 10 per cent grade for 300 meters.

The resurfacing of kilometer 7 of the Laoag–San Miguel first-class road and the construction as first class of kilometer 8 of the Laoag–San Miguel second-class road at a cost of ₱4,000 gave an addition of 1.3 kilometers to the present 6.7 kilometers of Laoag–San Miguel first-class road.

To protect the lower sections of Laoag–South Boundary Road from overflows of water, a surface treatment is being applied on those parts. A similar treatment on 100 meters in kilometer 5, San Nicolas–Batac section, is already completed.

An appropriation of ₱40,000 has been made by the provincial board for construction of San Nicolas–Dingras Road. This proposed project will connect with the San Miguel–Dingras Road at Milamilan. Total length, 14.7 kilometers, according to surveys lately completed.

The construction of a trail from Banna to Currimao–Badoc Road, a distance of about 27 kilometers, has been ordered by the provincial board, who appropriated for same ₱8,000. The opening of this trail will shorten the route between the fertile eastern section of the province and Badoc and Ilocos Sur Province.

ILOCOS SUR.

From January 1 to June 30, 1915, there have been constructed in the Province of Ilocos Sur and subprovince of Abra 13 kilometers of first-class road, 4 kilometers on the Vigan–North Road and 8.8 kilometers on the Vigan–South Road, both sections being a part of the Manila–North Road. Average cost per kilometer, including surcharges, ₱5,000.

One kilometer of trail between the municipality of Narvacan and the township of Nagbuquel has been made into a second-class road at a cost of ₱1,500, including surcharges.

Three kilometers of trail between the municipality of Bangued and Pidigan, Abra, have been made into a second-class road, standard width. Average cost per kilometer, including surchages, ₱2,500.

Construction work on the Santo Domingo market was commenced December 28, 1914. Some delay has been caused by not being able to get the materials ordered from the Bureau of Supply in time, some of them being still undelivered. The dimensions of the building are 18 by 42 meters. Total cost of construction up to date, including outstanding obligations and surcharges, ₱11,617.36. Percentage of work done, 70 per cent. Total amount appropriated, ₱16,839.36.

Construction work on the Cabugao market was commenced on December 28, 1914, and delay has been caused in the same way as on the Santo Domingo market. The dimensions of this market are 21 by 43.5 meters. Total cost of construction up to date, including outstanding obligations and surcharges, ₱11,242.32. Percentage of work done, 70 per cent. Total amount appropriated, ₱15,756.84.

A concrete spillway was constructed south of Lapog Bridge. The spillway is 71 meters long by 20 centimeters in thickness, is reinforced by ¼-inch steel and barbed wire, and is pierced with a quadruple 61-centimeter pipe culvert. Total cost of construction, ₱2,492.84.

Construction work on the Magsingal presidencia was commenced on February 1, 1912, with an appropriation of ₱6,939.99, not sufficient to complete the building in accordance with the plans approved by the Director of Public Works. Upon the exhaustion of these funds, the municipality requested a loan from the Insular Government of ₱4,000, which was granted on July 14, 1914. On account of not being able to procure the Insular funds immediately, the construction work was delayed. At the present writing the building is completed.

There are at present in this province and in the subprovince of Abra five buildings under construction and work has been stopped on account of lack of funds.

The construction work on the Singson waterworks was commenced on December 17, 1914 and at the present writing 90 per cent of the work has been completed, not including the installation in the houses. Certified expenditure up to June 16, ₱103,203.19; obligation, materials, ₱4,886.50; obligation by contract ₱1,500; obligation, surcharges, ₱1,394. Total expenditure and obligations ₱110,983.69; appropriation, ₱115,774.97; balance June 16, ₱4,791.28.

ILOILO.

The Dumangas presidencia was completed on June 9 and turned over to the municipality for occupancy. Temporary locks, bolts, etc., were allowed to be used, pending the arrival of the permanent fixtures from the States; on this account the contract cannot be closed. The work is excellent throughout, especially the woodwork. All of the latter is of narra and tindalo, beautifully finished. Much admiration has been expressed for the design of this little building and due credit should be given the Consulting Architect.

The new 20-room schoolhouse, constructed by administration in the city of Iloilo, was occupied by the division superintendent of schools on June 14. It is a very fine piece of work and when the grounds are put into shape, it will prove an excellent addition to the local list of buildings constructed by the Government.

Work on the Molo jetty is progressing very rapidly. The breakwater already extends over 400 meters out and the reclamation of property, for which the jetty was designed, is already noticeable.

The Consulting Architect has stated that plans for the customhouse will be, he hopes, finally completed about the 1st of August. The residents of Iloilo have become rather impatient for some evidence of this structure. Assurance has been given, however, that work will be started immediately upon the receipt of the plans and it is hoped that nothing further will prevent its being started at an early date.

Maps and data are still in preparation for the proposed waterworks on Guimaras. Interest in this project is very keen and if a sufficient supply proves feasible, the matter will be urgently placed before the Legislature.

Work on the extension of the river wall north toward Calle Remedios has been resumed under a contract with J. E. Ainsworth of Manila. All material is ordered, piling for about 100 lineal feet of wall is already in place, and before the heavy rains set in the wall should be well under way.

Calle Progreso in the city of Iloilo has been completely repaired and surfaced. A concrete sidewalk on the south side, the expense of which is borne by the property owners, is nearing completion, and as a result of this the entire locality is greatly improved and is assuming a very modern appearance.

Work on the Dingle School has been started by administration. No satisfactory bids were received.

No work has as yet been done on the Estancia and Balasan Schools, pending a request for additional money to cover the estimates. Both schools are so isolated that transportation charges are excessive and it is impossible to complete same under the appropriations made.

The steamer *Dredger* returned to Manila on June 1, the work planned having been accomplished and the appropriation exhausted.

A wooden structure to bridge the estuary on the Jordan Road, Guimaras, has been completed and the town will have a fine ½ kilometer of road connecting it with the bay by the middle of July.

The work on the San Miguel–Leon Road will be closed on the 30th of June, the money being nearly exhausted. It is hoped that more money will be provided next year to finish the remaining 5 kilometers up to Leon.

The work is being organized on the Tigbauan–San Joaquin Road. An appropriation of ₱20,000 has been set aside for the work this year and it is hoped that with this money we may be able to finish the road to Guimbal.

ISABELA.

The Cordon–San Luis Road will be completed and opened for traffic by the end of June.

Work on the Ilagan–North Road will be discontinued until probably next year, when more money will be appropriated for it. Out of the ₱20,000 loan between 5 and 6 kilometers have been made into a first-class road.

Four kilometers of subgrade have been completed on the Angadanan–Cauayan Road and surfacing is now under way. The location is a single tangent, and is almost a kilometer shorter than the old road.

The Bua culvert, 3 by 2 meters, in the municipality of Angadanan, is completed at a cost of approximately ₱1,600. This culvert has been built by voluntary contributions from the progressive town of Angadanan.

Four school buildings will be built this year: Plan No. 7 for Echague and Cabagan and plan No. 3 for Angadanan and Cauayan. Great efforts are being made to prepare details regarding the securing of Insular funds under the Gabaldon law.

A concrete presidencia, 20 by 15 meters, one story, is proposed for Cauayan.

A 2-ton auto truck is now on the way and will be established between Angadanan and Bayombong. The ferries at Ganano, Ipil, and Calao Creeks have been strengthened considerably in order that the truck may go over them without difficulty.

A 40,000-gallon concrete water tank for the Constabulary barracks will be commenced shortly.

LAGUNA.

During the past three months the metaling on the San Pablo–Nagcarlang Road has been extended 1.5 kilometers and 3 kilometers of very heavy subgrade work have been completed. For the past two months metaling has been suspended in order that the Calamba-Vigaa Road might be pushed to complete this section.

Work on the Calamba–Vigaa Road, 8.3 kilometers long, was begun in March, and there is now less than 3 kilometers remaining to be constructed. Grading on these kilometers is very light, and if the weather continues favorable the road will soon be completed. The old roadway was largely disregarded, and the new road shows considerable improvement both in line and grade. It is metaled 4 meters wide with 20 centimeters of stone (loose) and has shoulders 5 meters wide. All culverts have a clear road width of 7 meters. The shoulders are being sodded with Bermuda grass, and acacia trees will be grown from seed along the edge of the right of way.

The section of the Manila–South Road between Cabuyao and Calamba, kilometers 46 to 56, which was badly damaged by the sugar-cane traffic during the past grinding season, has been repaired and put in first-class condition.

The San Cristobal Bridge, a 22-meter reinforced-concrete open-spandrel arch, is practically completed and will be opened for traffic early in July.

The Pagsanjan Bridge, a steel truss 57.4 meters long with 8 I-beam approaches, is practically completed save the one approach which cannot be built until the right of way is secured by expropriation. The truss, donated by the Manila Railroad Company, was formerly part of the railroad bridge across the Calumpit River. Besides the roadway, 3.44 meters wide, it carries two sidewalks 1.75 meters wide for the heavy foot traffic that it is expected will develop.

All of the 8-inch pipe received has been laid for the San Pablo waterworks, leaving a gap in the supply pipe line of approximately 2 kilometers. The pipe that was to have been laid in this gap was jettisoned, and the operation of the system will be delayed until pipe is secured and this section laid. Considerable work has been done on the distribution system, but this also has been delayed by the failure to receive the valves that are a part of the system. They reached Manila on June 18, and now it will be possible, the weather permitting, to push the distribution system rapidly to completion, leaving only the 2-kilometer gap in the supply line to be laid after the other pipe has been received. In connection with the laying of the distribution system, we are laying out the street system of the town and monumenting it according to the plan for its improvement and beautification prepared by Architect Parsons. This is being done at this time so that the pipe can be laid to conform to the new street lines and grades, since the municipal authorities are planning to make extensive street improvements in the near future, and hope also to construct a sewer system within the next few years.

Several school buildings heretofore reported have been completed as follows: The high school at Santa Cruz has been completed by being painted. The Rizal Memorial School at Calamba has been completed by having the tower tiled and painted. This work was delayed, waiting for imported copper tiles. The Biñan schoolhouse repairs and painting have been completed. The No. 3 building at San Pedro has been completed and painted. The No. 2 building at Santisimo Rosario–San Pablo is completed and painted. A No. 2 at Santo Niño, San Pablo, has been completed but is not yet painted.

No new school construction has been authorized, but local funds are available in several of the towns, and authorization for further schoolhouse construction is confidently expected.

Construction by administration has been authorized and work begun on a forestry building at the College of Agriculture, Los Baños. This building when completed will be a Bureau of Education standard plan No. 7, but at present only two rooms and the assembly hall are being built.

The output of the Los Baños quarry for the quarter ending March 31, was 3,550 cubic meters, while that for the quarter ending June 30 will be approximately 10,500 cubic meters, far exceeding the output of any quarter since the quarry was opened.

LA UNION.

The first-class construction with 15-meter right of way of Bacnotan–North Road (Balaoan–Bangar section) mentioned in the April 1, 1915, issue of the BULLETIN, was about completed by June 30, with the exception of finishing up the shoulders and ditches. A loan of ₱40,000 has been requested from the Insular Government for the construction of the following bridges on this road:

Bridge No. 31.4, four 7-meter spans reinforced-concrete pile bent, Pantar Sur River.
Bridge No. 31.6, six 7-meter spans reinforced-concrete pile bent, Pantar Norte River.
Bridge No. 31.4, four 7-meter spans reinforced-concrete pile bent, Borobor River.

After the completion of these bridges and the concrete overflow sections, a continuous first-class road 24 kilometers long will be opened to traffic through the town of Luna into the subprovince of Amburayan, cutting out the big ferry crossing on the Busilac River between Luna and Bangar.

The new feeder road, first class, 15 meters wide and 410 meters long, to Bauang south railway station has been completed at a cost of approximately ₱2,900, including the expenses of moving several houses, purchase of land for the right of way, and the surcharges.

Preparatory to resurfacing the San Fernando–Bacnotan and San Fernando–Bauang Roads, active steps have been taken toward securing the necessary land for the 15-meter right of way for these roads, and the results so far have been very satisfactory. Most of the people, after having explained to them the necessity of a wide road on account of the rapidly increasing motor traffic, are willing to give up the required piece of land, and sign without hesitation the "memorandum de convenio" prepared by the Bureau of Public Works for this purpose. It is only in the town of San Juan where any opposition is met, and here only from a few of the wealthy owners and "principales" of the town.

The first heavy rain last May took out the Bauang River collapsible bridge, and automobile traffic to Bauang south railway station has stopped till after the rainy season is over.

Considerable progress has been made since last May on the erection of the Naguilian aërial cableway. The central pier is now up near the top, and the 17-ton counterweight is in place. There remains to be done the most interesting feature of the work—the swinging into position of the main cable.

An additional loan of ₱7,500 to the municipality of San Fernando has been approved. This amount will be expended on the construction of the San Fernando Central Barrio School as far as it will go toward inclosing the building. It is, nevertheless, estimated that with all of the above amount now available, nothing will be left unfinished except the ceiling and painting. The concrete partitions and all other concrete work have been finished, and the windows and floor joists are in place.

The San Fernando standard market, 24 by 42.8 meters, and the construction of a new 12-meter street, have been completed and accepted by the municipal council of San Fernando. The council requested the district engineer to construct a fence, similar to Bureau of Education standard school fences, with concrete posts, to inclose the market grounds, and materials for same have been ordered.

Bids for the construction of Bauang standard market, 18 by 42 meters, came out much higher than the estimated cost of the district engineer. The construction, therefore, will be done by administration.

LEYTE.

The maintenance question is still the most important that confronts the district engineer of Leyte. By the end of March the roads, although they had not been brought back to the parklike appearance for which they were formerly noticeable, had, nevertheless, been placed in good serviceable condition as traffice routes capable of handling all the extremely heavy type of traffic to which Leyte roads are subjected. It was considered that the general condition would continue to improve up to the beginning of the rainy season in September. However, increasingly heavy traffic of the iron-tired trailer variety coupled with a week's rain in May has put the Tanauan–Dagami section of the Palo–South Road in bad condition. The iron-tired trucks and tractors hauling iron-tired trailers of 5 tons capacity have plowed two lines of furrows from kilometer 21 to kilometer 29. This section is surfaced with river gravel from the Binahaan River, and while the gravel gave satisfactory results before the introduction of iron tires and concentrated loads, it has proven entirely unfitted to withstand the present type of traffic. In order to solve the gravel question for this section, all the surrounding country has been scoured for ledges or gravel deposits. One ledge has been found near kilometer 21, but unfortunately on the opposite side of the river and about 2 kilometers from the road. This rock is undoubtedly much superior to the river gravel and a quarry has been opened and a temporary bridge built across the river to enable a tramway to be laid from the road directly to the quarry. At this writing about half of kilometer 23 has been resurfaced with this stone, which, while it may not be all that is desired, is fully equal to other surfacing material in Leyte, the province being unfortunate in having all of its stone somewhat softer than the requirements for good surfacing material for heavy traffic roads.

The Palo–Tanauan section was entirely resurfaced between February and May. This resurfacing was put in 20 centimeters thick, using stone from the Palo quarry, but already kilometer 18, the first one surfaced, shows signs of wear.

The Tacloban–Carigara Road, excepting the Palo–Tacloban section, over which the Palo–South Road traffic passes, is in excellent condition, caused partly by the better resurfacing material, but chiefly by the fact that there is as yet no iron-tired traffic over this road, the present automobile traffic being limited to 8 or 10 passenger trucks with solid-rubber tires. As soon as the steel bridges at Dapdap and Mainit are finished the iron-tired traffic will undoubtedly develop on this road also. The only reason they do not run over it now is due to the fact that the temporary bridges at Mainit and Dapdap are not safe for loads of over 6 or 7 tons and the trailers and tractor weigh 20 to 30 tons when loaded.

The Mainit Bridge, two 180-foot steel spans at kilometer 31.4 Tacloban–Carigara Road, has been started by contract, the contractor being Mr. J. E. Ainsworth, whose bid for constructing the substructure and erecting the steel superstructure was ₱30,636. The only other bidder was the Atlantic, Gulf and Pacific Company, whose bid was ₱32,240.

The Dapdap Bridge, an 80-foot, bowstring truss at kilometer 24.4 Tacloban–Carigara Road, is about completed by administration and will be ready for traffic in a few days. The riveting cost ₱16 per 100. Bridge cost slightly under the estimate, which was ₱22,000.

The Guinarona Bridge, a standard 12-meter girder bridge on timber piles, has been completed by administration at a cost of approximately ₱8,200. Estimate, ₱8,900.

The Consolacion School, Bureau of Education standard plan No. 3 with movable partitions, has been completed by administration at a cost of approximately ₱8,000, including the 9½ per cent surcharge which is refunded. This building is in an isolated locality and can only be reached by boat once a month from Tacloban. Sand and gravel were donated.

The concrete piles for Cang-iglang and Labo-on Bridges, Maasin-Inopacan Road, did not show sufficient bearing, thus necessitating the driving of two extra piles and the lengthening of all piles by 1.5 meters. Also sand was poured around the piles to a depth of a couple of meters. Notwithstanding the extra cost involved by the soft nature of the foundation, these bridges will be completed under their estimated costs.

The construction of Palo–South Road (Dulag–Abuyog section) still continues at a satisfactory rate of progress. Since February 26, 10 kilometers of subgrade and 3 kilometers of surfacing have been completed. The road is 4 meters wide, the first course being spread 15 centimeters deep and the top course 10 centimeters deep, using 1,000 cubic meters of stone per kilometer. This project also involved the construction of a 91-meter collapsible bridge at kilometer 60.4, which was built in twenty-eight days, rather quick time considering that the piles were driven by a hand pile driver which worked day and night. This bridge was delayed somewhat on account of the time involved in getting the Oregon pine and the galvanized cable. As this bridge carries the tramway, the surfacing was help up for eight or nine days pending its completion.

As the contractor for the Tacloban market failed to display any signs of being able to finish the market within contract time, the work has been taken out of his control and will be finished by administration.

Concrete tables have been installed in the Palo market without an extra appropriation, as by doing the market work by administration a saving of ₱2,810.08 was effected which sum was used for the tables.

Concrete tables will also shortly be installed in the new Tacloban market.

On May 17 and 24 bids were opened for the Hilongos (18 by 42 meters) and the Ormoc (24 by 35 meters) markets, respectively. The lowest bidders in each case were Kipp & York, of Cebu, whose bids were ₱11,980 for Hilongos and ₱14,868 for Ormoc. As the administration estimates for these projects are ₱11,400 and ₱14,050, respectively, both projects will be done by administration.

The Bureau of Education is planning even a larger building program for this year than last year. We have already completed a No. 7, a No. 3, and a No. 2 plan school and are building a No. 2. In addition to these the following are planned: Three of No. 7 at Barugo, Baybay, and Naval, respectively, a No. 10 at Tanauan; three of No. 2 at Albuera, Tabontabon, and Tabango, respectively; and a No. 7 at Tacloban in connection with the trade school.

The hospital and jail roofs have been given coats of Deco paint and present a very good appearance.

Money has been appropriated for an annex 13.5 meters long to the provincial bodega. Material has been requisitioned and work will commence within two weeks. This annex will be same breadth as present building and of the same material, concrete floor with galvanized-iron roof and sides.

MINDORO.

The subgrade of the Calapan–Jolo Road is nearing completion. This is the first link of the proposed inland road from Calapan to Pinamalayan, which will also connect with the towns of Naujan and Pola by spurs from those towns inland to intersect this main trunk road. The road is of standard 15-meter width, of lowland section type, with fills varying from 30 to 80 centimeters, practically all earth for the fills being borrowed outside of the 15-meter right of way. This is rather unusual, but was possible in this case, because the road passes through virgin land. The country traversed by the road is very flat with but a slight slope toward the southeast. The grading was done with carabaos hitched to drag scrapers, each laborer furnishing two carabaos so that no time would be lost in resting the animals. Some of the laborers furnish three carabaos, but they receive no extra compensation for the third animal. Thus for the week ending June 5, 750 cubic meters of earth were placed at a unit cost of 47 centavos, including clearing, cutting of grass, and dressing up subgrade. The fill made with scrapers is found to be more compact than that usually made by hauling in carts.

Funds are available for two Bureau of Education standard plan No. 7 schoolhouses with concrete partitions, one to be erected in each of the municipalities of Naujan and Pinamalayan.

The surveys for the Calapan water supply are about completed. The water will be obtained from the Bulusan Springs located about 2 kilometers from Calapan. The present water supply is rain water, but there are no storage facilities, consequently most of the people of the town are without wholesome water during the dry season, this resulting in considerable sickness.

MISAMIS.

The road between Mahinog and Guinsiliban will be opened about the first week in July and the work is being continued so as ultimately to encircle the island. An interesting part of this road is a fill 5 meters wide and 400 meters long across the small bay of Binuni. The road will be protected by natural coral reefs. The fill averages 2.2 meters in depth, and is being laid with rock sides 1 meter wide.

Road work has recently been started between the municipalities of Talisayan and Gingoog. Other sections under construction are: A road on the Island of Camiguin, Cagayan–West Road, from Cagayan to Initao, 53 kilometers long; Cagayan–East Road, work on which is being done on the extreme eastern end; and Misamis–Baliangao Road, where work is in progress on several sections.

Jimenez Bridge, Misamis.

Structures authorized and under construction are the Misamis municipal building, the Misamis market building, the Medina school building, the Mambajao intermediate school building and the Cagayan wharf improvement.

The Cagayan–Talacag Road to the Bukidnon boundary has been completed.

The Alubijid–Initao section of the Cagayan–West Road is nearing completion and July 1 saw this project open to vehicle traffic from Cagayan to Initao, a distance of 53 kilometers. Upon the completion of this road an automobile will be requisitioned for use in this province.

The Oroquieta ferry work will soon be completed. The barotos furnished by the local contractor, Mr. Vicente Fortich, were delivered last month and the materials requisitioned through the Insular Purchasing Agent were promised for the end of June. The construction work will then be finished in three weeks.

Talagusoc–Initao Road, Misamis.

Volunteer labor and lumber are being secured for one first-group timber bridge at Langaran, which will be a replica of one of the spans of the recently finished Jimenez wooden bridge.

BUKIDNON.

The Province of Bukidnon has made considerable progress on road and bridge work. Old wooden bridges in several instances have been replaced with American ingot iron corrugated culverts. Grades have been eased and relocations made which have materially improved the principal road, which leads from the Misamis boundary near Diklom to Malaybalay, the capital of Bukidnon.

The continuation of the Cagayan–Talacag Road in Bukidnon Province has progressed considerably and is about 50 per cent completed. This road leads to the subcapital of Bukidnon which is about 40 kilometers distant from Cagayan and of which about 30 kilometers are in Bukidnon Province. Mr. Albino Noble, the subgovernor, has been placed in charge of this work and Marcelino Angeles has charge of the main road work between the Misamis boundary and Malaybalay.

Moroso, or delinquent cedula labor, is being used extensively in Bukidnon Province.

Buildings authorized are the provincial capitol building and provincial jail building.

The Philippine Development Company operating in this province have placed an automobile truck, which is now running almost daily between Cagayan and Tanculan, a distance of 40 kilometers. A large caterpillar traction engine has also been placed in service with very satisfactory results. An additional traction engine for their use is due on the steamer *Lanao*. The truck has been placed at the disposal of this office for transportation purposes free of cost where public works are involved. This speaks volumes for the public spirit of this company. The erection of a wooden pantalan is being completed by this company at the barrio of Agusan, which would be the logical port for Bukidnon Province in fair weather. Boats drawing 5 fathoms of water can now almost throw a gangplank from ship side to shore.

NUEVA ECIJA.

Seven kilometers of grading has been completed on the Gapan–Cabanatuan section of the Manila–North Road, done with carabaos and scrapers. The ground is first plowed. The scraper used is the ordinary native steel harrow, 1.5 meters long, covered with bamboo to about 20 centimeters of the end of the teeth. If the ground is well plowed, it will carry $^{2}/_{10}$ of a cubic meter. Grading can be done in this way for 18 centavos a cubic meter, where the haul is not more than 30 lineal meters.

Twelve kilometers of surfacing has been repaired on the Gapan–Cabanatuan section and the entire road, with the exception of the grade mentioned above, is a good second-class road.

Seventeen reinforced-concrete culverts, one 6-meter girder bridge, and 8 kilometers of surfacing have been completed on the Guimba–Pangasinan section of the Manila–North Road during this quarter, making the road first class to kilometer 167.

Four kilometers of grading has been completed on the San Antonio–Jaen Road and it is expected to extend this road to connect with the Manila–North Road just north of Gapan.

Two kilometers of grading and 21 reinforced-concrete culverts have been constructed during this quarter on the Baloc–San Jose Road. This is one of the most important branch roads to the Manila–North Road, and, owing to the shortage of funds, the culverts were constructed before the grading was done in order to keep the road open to traffic during the rainy season.

Grading with carabaos and scrapers, Gapan– Cabanatuan section, Manila–North Road, Nueva Ecija.

Various methods have been tried on the maintenance of first-class roads and it has been found that the regular maintenance with 1 caminero to 1 kilometer, or 1 caminero to 1.5 kilometers, proves the most effective. In the delivery of gravel for maintenance of first-class road, a Buffalo-Pitts road roller is used to pull the gravel carts. The road roller can haul 20 carts with ½ cubic meter of gravel each, and will travel 4 kilometers an hour. On an average haul of 6 kilometers, gravel can be delivered for 15 centavos per kilometer meter. This is very cheap transportation and is also very beneficial to the road. Care must be taken in getting around sharp curves and in some cases it may be necessary to cut the train of carts in two and pull half of them around the sharp curves at a time; this, however, caused but little delay. In hauling gravel with the road roller no cleats are used on the wheels and it is sometimes necessary to use a rope or cable to pull the carts out of the gravel pit as the roller cannot pull in loose gravel.

Grading with carabaos and scrapers, Gapan–Cabanatuan section, Manila–North Road, Nueva Ecija.

All temporary crossings on the Manila–North Road have been kept repaired and the entire road in this province is still open to traffic.

Work on the substructure of the Talavera Bridge is about 80 per cent completed, but the work is progressing very slowly on account of the poor equipment used by the contractor. The steel for the superstructure has just been completed by the Atlantic, Gulf and Pacific Company, but it will be impossible to erect this steel until the end of the rainy season.

Cabanatuan market was completed on May 8 and turned over to the municipality. This is the first standard market building constructed in the Province of Nueva Ecija.

Kilometer 144, Manila-North Road, Nueva Ecija, showing overflow section planted with trees.

Work on the Cuyapo market is 80 per cent completed. Tan Samco is the contractor.

Contracts have just been let for the construction of market buildings in Peñaranda and San Isidro.

Many applications for water rights are being received and great progress has been made in small irrigation projects throughout the province.

OCCIDENTAL NEGROS.

The subgrade work on the Victorias–Manapla Road is progressing very rapidly, it being now at station 40+300 on the Victorias side and at station 43+520 on the Manapla side. The 3½ kilometers left will be completed by September. Plenty of surfacing material is now available for this road and hauling of same will be started very soon. A contract for the three 13-meter span reinforced-concrete arch bridges was awarded to Mr. J. W. Ford of Iloilo, and for the 20 culverts to Messrs. French & Berlew of Iloilo. The contract time for completing the bridges is 240 days and the culverts 120 days. This is the most important project in the province and involves the expenditure of ₱128,000.

The 3 reinforced-concrete pile-and-girder bridges on the Alicante–Victorias Road were completed this month by contractors W. H. Lambert & Co., of Iloilo. The Severino Bridge over the Malijao River, of seven 7-meter spans, is named after an Assemblyman of this province, the Honorable Melecio Severino, who recently died, losing this province an enthusiastic supporter of public works. The Caruguiat Bridge is of three 7-meter spans, and the Luñga-og Bridge is of two 7-meter spans. The surfacing work to Victorias is now completed and the road open to traffic.

The Prize Bridge over the Tabigue River was completed last month by contractor J. W. Ford of Iloilo. This is an ornamental bridge on the Bacolod–North Road just outside of Saravia. This bridge was built with the prize money obtained by this province on the interprovincial road competition in 1914.

The timber collapsible bridge, 103.7 meters long, over the Malugo River, constructed by administration, was finished and opened to traffic last April. The cost of the work was well within the estimate.

The San Carlos market building, type B, size 24 by 42.8 meters, was completed last month and turned over to the local officials. This is the first type B market in the province and is a very handsome structure. Situated as it is in the midst of a very prosperous and growing section it bids fair to become quite a show building. W. H. Lambert & Co. were contractors for the building.

The Maao market building in the municipality of Bago is now being advertised. The bids will be opened on June 25.

The reconstruction of the 2 kilometers of road from Patic to the port of Pulupandan is nearing completion and the surfacing is already started. This is a very important stretch of road for the large and increasing traffic between this port and the south of the island.

By the end of the month 14.3 kilometers will be recommended for designation as first-class road. This makes a total of 131.4 kilometers first-class road in the province.

Surfacing work for the La Carlota–La Castellana Road between Candaquit River and Antipolo on the Bacolod–South Road begins next month and will be completed by the end of the year.

Surfacing on the Hinigaran–Isabela Road is being pushed rapidly and is now at kilometer 67. The Insular loan requested for a permanent bridge over the Binalbagan River on this road has not yet been approved, but unofficial information is to the effect that the money will be made available.

The subgrade work on the Binalbagan–Kabankalan Road is being rushed to rapid completion; about 7 kilometers is now completed on the Kabankalan side and 12 kilometers on the Binalbagan side. Only 7 kilometers more are left on this project. Surfacing materials are being delivered and hauling will be done by tramways loaned by the hacenderos of the vicinity.

Surveys have been made for market sites at Cadiz and Bacolod and for the municipal building of Bago. Also for bridge site at Suay River, Bacolod–South Road, and for a pier site for the port of Pulupandan.

Protection work is being done for the Imbang Bridge, a fine structure valued at ₱40,000. The work consists of a row of concrete sheet piles with a parapet wall connecting the bridge abutment to the outcropping baquias above the bridge site.

The following is the itinerary of the two artesian well boring rigs in this province: North—Sagay, Cadiz, Manapla, Victorias, Saravia, Silay, and Talisay. South—Pontevedra, Hinigaran, Isabela, Binalbagan, Himamaylan, Kabankalan, Ilog, and Cauayan. Two or three more wells are being made in each of these towns.

ORIENTAL NEGROS.

Pipe culverts, both concrete and corrugated iron, are being installed on the Zamboanguita–Siaton Trail. The trail has also been widened until it is passable for carts.

The market and school buildings at Tanjay have been completed and accepted. These were constructed by contract. A market at Guijulñgan has been finished by administration. Materials have been ordered for sanitary concrete tables for Dumaguete and Guijulñgan.

Construction of the Bais–Tanjay section of the North Road is now going on both north and south of Bais. Seven culverts have been built and three more are under way south of Bais. Rock is being taken from a quarry opposite kilometer 41 and a second quarry opposite kilometer 38 opened up. North of Bais two quarries will be used, one opposite kilometer 47 and the other at kilometer 49. All rock from kilometer 46 to 51 is being broken by hand and will be hauled and distributed by contract with the hacenderos, who furnish their own track and cars. Labor has been scarce until recently, but with the ending of the sugar season the force is increasing.

Nearly all piles and other materials for a small pier at Canoan have arrived. Worked will be started on this in July.

Bids were opened on June 1 for constructing a 7-room school at Larena, Siquijor. The provincial board has awarded the contract to Kipp & York of Cebu, the low bidders. This building is to be used for the subprovincial intermediate school.

PAMPANGA.

Surfacing on the San Fernando–Calumpit section of the Manila–Tarlac Road was finished on June 13, 1915. This road connects with the Calumpit–Quiñgua Road (Bulacan Province) now under construction. The distance from San Fernando to the provincial boundary is 14.7 kilometers. The entire road in this province has a Telford base, the second course consists of 6 centimeters crushed stone and the third course of a mixture of screenings and gravel, the latter being used when it was impossible to secure sufficient screenings. The Telford and broken stone were secured from the Arayat quarry and the gravel from the Quiñgua River. Over 1 kilometer of this road is oiled.

While at first some difficulties were encountered by this office on the Manila–Tarlac Road work in Apalit, the people are now unanimous and our chief supporters in scientific and standard Bureau construction. The widening of right of way on the Macabebe Road from the Manila–Tarlac Road to the railroad station has enabled them to secure a first-class road to the station. The municipal council has also selected a new line from the municipality to the Manila–Tarlac Road, connecting with the Macabebe and Apalit Station Road. This proposed road is from 50 to 75 meters from the Pampanga River and is parallel to the Arnedo–Dyke Road. It is more permanent, as it is not liable to encroachment by the river. Upon the municipal officials securing a 15-meter right of way the province will construct this road as first class.

The Angeles–Porac Road is being resurfaced and when finished will be a first-class road in fact. Partial resurfacing last year made the road more comfortable than before and the additional surfacing will make it more durable and require considerable less maintenance. On this road the abutment of the Pasig River bridge which was undermined last year was replaced by a new one. To prevent scour, steel sheet piling capped with concrete was driven along the abutment and on the upstream side.

The Mexico Bridge (No. 78.4) on the San Fernando–Arayat Road was finished in June. Its span is 10 meters and is constructed with the new Bureau balustrade.

Resurfacing on 7 kilometers of the San Fernando–Lubao Road and 4 kilometers of the Guagua–Santa Rita Road will be commenced in July.

Seventy per cent of the first-class road declared prior to January 1, 1914, is now of standard 15-meter width and but few places remain where it is practicable or possible to widen without going to considerable expense. Each and every fence moved was with the consent of the adjoining property holder.

The progressive municipal council of Guagua have applied for a loan for constructing standard market tables. They have also deposited ₱3,000 with the provincial treasurer for constructing a portion of an additional permanent market building. They prefer a permanent building to a larger temporary structure.

The San Fernando Central School is under construction. This is a plan No. 20 with the four rooms omitted.

The Sexmoan (plan No. 4) and the Magalan (plan No. 6) Schools will be started during the next quarter.

PANGASINAN.

The Calvo Bridge at Bayambang was dedicated on April 24; the official fiesta of Bayambang. Provincial and municipal officials joined in celebrating the opening of the bridge to traffic.

The Binalonan market, a standard plan, 21 by 43.5 meters, type B building, has been completed. Standard fish, meat, and vegetable tables have been installed.

The Dagupan–San Carlos Road is progressing rapidly. Grading has been completed from Dagupan to Buenlag, a distance of 8 kilometers. Surfacing has been finished to Calasiao, a distance of 4.7 kilometers.

The Calasiao–Santa Barbara Road will be entirely completed by the 15th of July.

The Lingayen–Mangatarem Road has been entirely completed. As there is now a good ferry at Salasa all classes of traffic may use the road without interruption.

The completion of the Rosales–Umingan Road has been delayed due to changes in alignment between Carungayan and Umingan. The section between Carungayan and Rosales has been completed.

The 4 kilometers of the Tayug–Umingan Road in the vicinity of Umingan have been surfaced as first class.

Due to the recent work accomplished on the Rosales-Tayug Road, the mail for the municipalities in the northeastern part of the province are now delivered via railroad at San Leon.

Grading on the Tayug–Santa Maria Road has been completed and partially rolled and surfaced. Due to shortage of funds, work has been suspended until January 1, 1916.

One-half of the Tayug-Natividad Road has been graded and rolled. Surfacing started during the second week of June.

Investigations are being made at Villasis with the view of constructing a steel bridge across the Agno River at that place.

Contractor Tan Samco of Manila has already completed 4 of the 15 culverts which he is to build on the Manila–North Road south of Rosales.

The provincial board designated as first class on July 1, 1915, the following roads:

Designation.		Stations.	Kilometers.
Letter.	Name.		
A	Manila-North Road	From 175.9 to 145.2	69.2
B	Rosales-Nueva Vizcaya Boundary	From 185.0 to 200.0	15.0
B	Rosales-Nueva Vizcaya Boundary	From 205.0 to 223.3	18.3
F	Rosales-Tarlac Boundary	From 191.8 to 209.9	18.1
L	Urdaneta-Calasiao Road	From 221.8 to 227.6	5.8
N	Binalonan-Tayug Road	From 211.4 to 225.4	14.0
N	Binalonan-Tayug Road	From 227.6 to 229.4	1.8
T	Pao-Lingayen Road	From 221.7 to 256.3	34.6
Y	Dagupan-San Carlos Road	From 243.1 to 247.8	4.7
	Lingayen Plaza	From 247.8 to 248.2	0.4
L	Lingayen-Mangatarem Road	From 247.8 to 276.8	29.0
	Total		210.9

This represents an increase of 38.4 kilometers over that designated on January 1, 1915.

The municipality of Bani has requested surveys and investigations with the view of obtaining a water supply from the gorge, 2 kilometers west of the plaza.

Construction of the Alaminos and Umingan schoolhouses has been started. These buildings are the standard plan No. 10.

In the near future standard two-room schoolhouses are to be constructed in the barrio of Estanza, Lingayen, and at the barrio of Magtaquing, Salasa.

RIZAL.

The contractor for the construction of the Pasig Provincial High School has been placing concrete steadily since the beginning of April and will probably complete this part of the work early in July. Progress has been very slow because of difficult labor conditions. Material for the roof has all been received and is being framed so that the roof will be in place very shortly after the concrete is all placed. The contract for the electrical installation has been awarded to the Strong Machinery Company at a price of approximately ₱2,200. The fixtures for this installation are all high grade and in keeping with the general architecture of the building.

The Antipolo kioskos were completed in time for the annual fiesta early in April and have been accepted by the municipal council. The total cost of this project, exclusive of some planting and gardening which remains to be done after the rains commence, is ₱11,522.92.

Plans and estimates have been prepared for the installation of a 5,000-gallon tank as a water supply for the Pasay market and immediate vicinity. A deep-well pump will be installed to be run by a small gasoline engine giving a capacity of about 1,000 gallons an hour. This project is being held up temporarily pending the accrual of sufficient revenues from the market.

A 4-room standard schoolhouse to be built in Taytay has been authorized by the Director of Education with an appropriation of ₱9,750. This is being built by Juan Alfonso, a local contractor, for the price of ₱5,749, the Government supplying cement, steel, galvanized iron, gravel, and sand. Good progress is being made and a very good class of work being secured.

A No. 4 standard schoolhouse with two additional rooms has been authorized, with an appropriation of ₱12,000, for construction in Parañaque. The addition of these two rooms makes the structure more complicated than the average standard school. Construction was held up for some time pending the arrival of suitable plans from the Bureau of Education. Material has now been ordered, however, and a subcontract has been placed for labor and local transportation at a price of ₱2,700.

Estimates have been furnished the division superintendent of schools for a No. 4 standard plan building for San Felipe Nery and No. 3 building for Las Piñas. It is anticipated that these allotments will be made and construction commenced within the next few weeks.

A standard plan schoolhouse is in project for the municipality of Cardona as soon as a suitable site is secured.

A small appropriation has been obtained for the repairs of the wooden schoolhouse at Montalban. This work will be done by the municipal president under the supervision of the district engineer.

A standard plan 21 by 39.8 meter market has been advertised for the municipality of Navotas. This municipality is on an island in Manila Bay and has very few public improvements. A loan from the Insular Government of ₱15,000 is available for construction.

Plans have been prepared for an ₱18,000 market in San Juan del Monte. Plans are also being prepared for a standard concrete presidencia costing about ₱14,000 in the same place. These will be advertised at the same time as soon as the presidencia plans have been completed. The municipality has already secured the necessary sites and has quite a sum of money appropriated for the work. The balance required will be a loan from the Insular Government.

The window grilles on the provincial jail are being strengthened by the placing of additional cross reinforcements.

All municipalities of the province, with the exception of those on the Manila–South Road, are now connected by telephone. The stringing of lines on the Manila–South road has been held up temporarily pending an agreement for the use of various lines of poles already placed on this road. These telephone lines are intended strictly for official business. They may be used for commercial business, however, on the payment of a small fee.

Plans are being prepared by the designing engineer for three concrete bridges on the Angono–Binangonan Road. An Insular loan had been secured for the construction of these bridges and they will be begun as soon as practicable after the rains. The construction of the Angono–Binangonan Road has been practically completed. This road is an extension of 8.3 kilometers of the Manila–East Road from Angono to Binangonan. The country is very low, the road extending along the shore of Laguna de Bay, and quite heavy grading has been necessary to raise the road above the flood level of the lake. Broken-stone surfacing has been placed on a 4-meter width. The cost has been ₱45,000, or ₱5,500 a kilometer, including culverts and irrigation siphons but no large structures. There is a balance of about ₱15,000 to grade the road to Cardona. Additional provincial funds will be available during this year to metal this extension.

Timber trestle bridges have been completed over the Taguig River in the población of Taguig and the barrio of Boting. These were both constructed of first-group materials according to the standard plan of the Bureau of Public Works for timber trestles. The Taguig Bridge is a wagon bridge, while that at Boting is intended for foot traffic only. The cost of the structures was approximately ₱8,000.

Artesian water has been struck in the municipality of Pasig after various unsuccessful attempts in the past years. A good pumping well has been secured across the Mariquina River. It is planned to place a large concrete tank on top of a near-by hill and lay pipes for a gravity supply throughout the poblacion.

A comprehensive program for drilling additional artesian wells throughout the province has been in course of preparation since the beginning of January. It has at last been completed. Twenty towns of the province have requested from one to nine additional wells each. The necessary resolutions have been received, approved, and guaranteed by the provincial board, making a total of 67 wells to be drilled during the present year.

SAMAR.

Third-class road construction was commenced April 19 last on project 72 to connect Catbalogan with Wright. A road gang is now busy in the vicinity of Catbalogan. A second gang has been started at Wright. The maximum gradient will be 6 per cent, so that at any future time the road may be made first-class without the necessity of relocation.

This road is part of a general scheme to connect up isolated sections of roads now existing. The scheme includes the Wright–Taft Trail from the west coast to the east coast of Samar; the connecting of Calbayog with Catbalogan; of Calbayog with Catarman; and of Taft with Sulat. The latter section is now complete, subgrade and surfacing. When completed, a man on horseback could make a continuous trip of some 325 kilometers without retracing his steps. Of this distance 106 kilometers can now be covered by automobile; not all of it, though, being first-class construction.

All of the culverts between Sabang and Oquendo of the Calbayog–North Road will soon be completed.

The Borongan–South Road work has come to an end through lack of funds, after completing about 19 kilometers of third-class road. The balance of the appropriation is being expended on three ferries and a number of culverts.

The Carangian–Laoang Road is being surfaced with coral rock as rapidly as circumstances permit. There is no beach gravel anywhere along the north coast of Samar. River gravel is scarce and miles away from the road.

The seven reinforced-concrete slab and girder bridges on the Calbayog–North and South Roads have been completed.

Bermuda grass and acacia trees have been planted along the whole of the Guiuan–Salcedo Road. The grass makes a fine carpet for pedestrians, while the acacia trees are springing up and will soon serve the purpose for which they were set out, viz., the giving of shade. The same policy is being pursued on other roads, and in a few years all should present the same appearance. In many instances nut-bearing and fruit-bearing trees are taking the place of the acacias.

A No. 7 standard school is being erected in Oras, and a No. 3 at Dolores. Papers are under way now for a No. 3 at Balangiga.

The Catubig schoolhouse, a No. 7 building, is the last school project finished. It was erected by administration.

The subgrade and metaling on the Sulat Road has been finished.

SORSOGON.

The drought that has been so severe in most parts of the Philippines did very little damage to the roads in Sorsogon; the only road not now in the best of condition being the Bulan–Irocin Road. This road has needed resurfacing for some time, but to do this by hand would have been an expensive and almost impossible job, therefore, the province purchased a 10-ton Kelly Springfield road roller from the Bureau of Public Works, and now the work of resurfacing is going ahead very satisfactorily and economically. In Masbate the drought was felt more severely until the end of May when a severe rainstorm passed over the Aroroy district and did considerable damage to the road from the Colorado landing to the mines; this has since been repaired.

A radical change has been made in the location of the Sorsogon–South Road. This road when completed will run from Gubat in a southwesterly direction to the Barrio of Escuala. From here there will be a branch 7½ kilometers long running northwest to Casiguran, while the main Sorsogon–South Road will proceed almost due south and join the Bulan–Irocin Road at Mombon. This road is a good deal shorter than the original location which passed through Barcelona and Bulusan to Irocin; moreover, it connects Casiguran, possibly the biggest shipping port in the province, with the majority of the other towns. Six kilometers of grading and 3 kilometers of surfacing have already been finished on this new location, while the old road from Gubat to Bulusan will be completed as a second-class road by the 15th of July.

Work was started on reconstruction of the Donsol–Pilar Road in May. This road, which is to be second class, presents but few difficulties, one of these being the repair of the Ogud River Bridge, 6 wooden spans of 14 meters each. The piers and abutments are concrete (one of which has sunk about a meter) and the original superstructure has completely rotted away. The municipalities of Pilar and Donsol have obtained authority from the Executive Secretary to accept voluntary contributions of material, labor, and money to repair this bridge, but up to the present time no contributions have been made.

As no bids were received for the Bacon market, materials have been ordered and the work will be done by administration.

Plans have been received and bids will be opened on July 6 for the construction of a new provincial building and a new jail and courthouse.

The construction of the Lumbang–Milagros Road from the Subanacid River to Milagros has been continued. In this section of the country the condition of the people is so bad that a number are working for ₱0.25 a day and a ganta of rice, all others are working for ₱0.50; the original rate of wages in this district was ₱0.75 a day.

After considerable trouble an artesian well was completed in Irocin, pumping about 10 gallons a minute; a second well now being driven is about 300 feet deep, but no water has been found as yet.

SULU.

Work is progressing rapidly on the Sulu Public Hospital, and the project will probably be completed about July 31. An additional ₱6,000 has just recently been received for finishing the work.

Heavy maintenance and construction work is continuing along the Jolo–Parang and Jolo–Maibong Roads. Corrugated steel culverts have been placed in most places where needed, ditches widened, and rock placed on various stretches.

These 36 kilometers of mostly mud road have been kept open through the present rainy season to an automobile traffic averaging 12 trips per day. We have had three months of rainy season, with approximately 17 inches of rainfall in June.

The causeway in Maibong, 250 lineal meters, has been elevated 30 centimeters to raise the road above high tide.

Preliminary investigations of Gandasulin Springs have been completed and plans for plants are nearly ready for approval. This is for the Jolo water supply.

Topographic maps have been prepared for Jolo and Maibong market sites.

A No. 6 school plan has been prepared, revised, to meet the requirements of a wooden structure for the Lapac Industrial School on the Island of Lapac.

Plans and estimates have been prepared for the future dock and town development of Jolo.

Surveys of the Jolo, Maibong, and Parang Roads are being made, and the field work will probably be completed in another week.

All the poles have been placed for the Jolo–Seit Lake telephone line, 33 kilometers.

The completion of the work has been delayed on account of not having insulators, which were ordered six months ago.

Nearly all the streets in the town of Jolo have been resurfaced with coral.

SURIGAO.

There have been constructed during the past quarter 3 kilometers of subgrade on the Placer–Mainit Road, and the remaining right of way, some 6 kilometers of timber overgrowth, are now cleared. Work is now suspended through shortage of funds.

Five kilometers of subgrade have been constructed on the Surigao–Sison Road and there remain 4.86 kilometers to be subgraded. This

4.86-kilometer stretch follows the course of the Sison River and is on a hill side. There has been some difficulty in clearing the right of way as some big standing trees have been encountered. This work is also suspended through shortage of funds.

In order to increase the utility of the Surigao–Sison Road, it has been found necessary to connect same to Placer–Mainit Road from Sison to Badas, a distance of 7.84 kilometers. This section also passes through a very rich valley, and 2.5 kilometers are now subgraded. The remaining 5.34 kilometers have been mostly all cleared.

Labor for constructing complete the Linging Barrio School, Bureau of Education standard plan No. 2, has been advertised. Bids are to be opened on July 3. This school is in the most southern part of the province and transportation is very difficult and costly. The only way to transport materials for this building is to charter a steamer costing about ₱300 from Surigao town. This building has been talked of for the last four years.

Surveys and investigations for the site of the proposed Surigao wharf are now being made. There has been allotted by the Honorabe the Secretary of Commerce and Police ₱40,000 for this project.

AGUSAN.

This province has only been added recently to the office of the district engineer of Surigao.

The main projects in this province are: The construction of Butuan provincial jail and the construction of Butuan–Cabadbaran Road. This road was started sometime in 1909 by the provincial authorities under the jurisdiction of the Honorable the Secretary of the Interior, and is more than 28 kilometers in length. Over 8 kilometers were surfaced and bridged with timber bridges by the provincial authorities and over 4 kilometers have been surfaced this year. Gravel for these 4 kilometers was hauled over 3 kilometers from the road by tramway. There have been graded 17 kilometers in all, 2 of which have been done this year, and there yet remains about 11 kilometers to be subgraded. The clearing of the right of way has all been completed. Nine kilometers have been done during the past quarter by contract at ₱200 per kilometer. It may be interesting to add that clearing by day labor was costing the province between ₱300 and ₱400 per kilometer. The district engineer has no assistant on this work, but Governor Guingona is taking a personal interest in the supervising of this work.

The construction of Butuan jail, a 1-story concrete building with iron roofing (21 by 26.1 meter), was started by the Butuan authorities sometime in July of last year, but, due to a scarcity of labor and shortage of funds, the building has not been completed as yet.

Plans are now being prepared for a bridge over the Baan River. This river is more of an estero and is the second largest water crossing on the Butuan–Cabadbaran Road. The bridge will call for concrete pile substructure and timber superstructure. It is believed that no timber piling can resist the teredo action on this estero.

The clearing of the right of way of Butuan–Libertad Road is now being pushed. The road has a total length of 5 kilometers and passes through a very thickly wooded country, which is being subdivided into homesteads.

There has been approved recently by the provincial board, the construction of a ground-circuit telephone line from Butuan to Cabadbaran. It will follow the road and it will be a great benefit to Cabadbaran, the most progressive town of the province.

TARLAC.

The Camiling presidencia is now about 98 per cent completed, lacking only the necessary locks and part of the metal ceiling. In all probability the cost of this building will not exceed ₱28,000.

Work on the following schools is now going on: Sinilian Barrio School, Calibangbang Barrio School, and Balincanauay Barrio School. All these schools are standard No. 2 schoolhouses of the Bureau of Education.

Authorization to construct a Bureau of Education plan No. 3 schoolhouse in the municipality of San Manuel has just been received and work will be started as soon as practicable. Authorization to construct a similar school in the town of Bamban has also been received.

The construction of the Pura–Guimba Interprovincial Road will be started in about two weeks, and if the Nueva Ecija authorities will simultaneously construct their part—only about 5 kilometers—it will not be long before direct automobile connection is established between Tarlac and Manila.

Work on the Tarlac–La Paz Road construction is rather slow at present, but as soon as the roadroller is repaired the work will be pushed rapidly.

The province is about to obtain a loan of ₱66,000 for the construction of the Camiling Bridge. The honorable provincial board, especially its president, the Honorable Hernesto Gardiner, have been working continuously for the last four months toward the realization of this loan. This bridge, according to plans already prepared by the Bureau of Public Works, will be a two-span steel bridge.

The district is endeavoring at present to plant the borders of all of its first-class roads with mangos and pilis. The mango seeds are now being prepared as follows: Good-sized bamboos are cut into tubes about 10 inches in length, and these filled with the proper kind of earth. One seed is planted in each tube and then kept in a damp place until the young plant comes out. After the plants have acquired at least four leaves the sun's rays are gradually let in on them, taking care not to subject them to excessive heat all at once. The seeds thus prepared can be transported almost anywhere without danger of dying. For permanent planting, a hole is dug to the proper depth and after the bamboo tube is removed carefully by breaking and without disturbing the roots, the young plant is placed in the hole and then protected carefully by placing a fence around it. This method of planting has been found very satisfactory as far as mango is concerned and same will be followed in preparing pili seeds. The district engineer of Albay has been very kind to furnish this district with a sack of this valuable seed.

TAYABAS.

Investigations are being made of various routes for a road to connect the Manila–South Road and Bolboc, Batangas. It is hoped that the coming year will witness the inauguration of actual construction.

Construction of the Tayabas–Lucban Road has been steadily carried on during the quarter. There are now about 500 men employed. Heavy cuts, necessitating the removal of about 2,000 cubic meters of dirt and bowlders to the cut, on the average, have been encountered at various points, thus delaying the completion of the kilometers where they are located. Sand for culvert construction costs from ₱10 to ₱12 per cubic meter on the job and coal averages about ₱25 per ton, delivered. Heavy rains are interfering with the grading and will probably retard the work considerably. Grading has reached kilometer 17.0 and surfacing has been placed over a considerable portion of this distance, omitting the heavy cuts, where grading is not yet completed. Automobile parties from Manila have increased in numbers due to the popularity of the road and many week-end parties now make the trip to Atimonan.

Repairs to the 50-foot steel tower of the range light at Pisñgi, near Lucena, have been completed. The work consisted of constructing a riprap base of one-man stones to prevent scour, and of painting the tower. One hundred seventy-two cubic meters of stone were used, and the total cost of the work was ₱866.65.

The quarter ended June 30 has witnessed the completion of several projects in this district. Lucena market building, a 21 by 47.2 meter type B structure and a block of four double tiendas, has been completed by administration. The total cost was ₱28,364.02 The municipality has completed a small matadero by local contract and now has a very presentable market plant.

Tayabas market building, 24 by 42.8 meters, type B, was completed by the contractor, Mr. John Gordon, during June. The total cost was ₱20,730.74 and the workmanship is first class. The municipality has completed a small matadero at a contract price of ₱1,500, and a very considerable increase in market collections is expected as a result of the operation of the two new markets.

Construction of the Mauban market was completed at a cost of approximately ₱18,635, of which more than ₱2,000 was expended on grading the site around the building. This was an administration project. The building is a type B, 21 by 43.5 meter structure. The municipality has connected their water-supply system to the municipal building and to the market.

The Atimonan market building, type B, 21 by 43.5 meters, was completed by administration during June, 1915. The total cost will be approximately ₱18,000.

Construction of a block of eight double 4 by 4 meter tiendas has been begun by administration at Sariaya. The contract for Sariaya matadero, a modern 12 by 25 meter structure, has been awarded to Contractor Tan Samco, of Manila for ₱7,548. Work has been started and should be completed in record time.

Alabat School building, a plan No. 3 structure, was completed June 1, 1915, by administration. The isolation of the work and labor difficulties made the cost of this work, ₱9,430.19, much higher than usual. A street has been opened up to the school site, using Act 1932 funds, and the plant is now in first class condition.

MARINDUQUE.

The Gasan–Buenavista Road has been completed into Buenavista and the whole road is being put in good condition. One and one-half kilometers of road were constructed for ₱2,000.

Approximately 1 kilometer of very good trail has been completed within the municipality of Santa Cruz, using Act 1932 funds. Funds from this Act accruing to the municipality of Torrijos were sufficient to construct 1 kilometer of trail in the latter municipality.

The Boac woodworking shop is being inclosed and put in condition for use at the beginning of the school season.

Investigations are being made for a proposed bathhouse at Malbog Springs and a short first-class road to connect the springs with Buenavista. These springs are of a hot sulphurous character and are in high repute for medicinal properties.

Preparations are being made to advertise a slab and girder pile bridge and a No. 7 standard plan school building to be constructed at Gasan.

Automobiles have made their first appearance on the roads of Marinduque, and a Ford is now operating between Mogpog and Buenavista.

ZAMBALES.

Pamatauan bridge No. 62.9 on the Iba–South Road is now about completed. Upon its completion, the province will have a continuous stretch of road 36 kilometers in length from San Felipe to Subic, passable for carts during the entire year. This is the most important road in the province, having an average daily traffic of 170 carts, one way. The rest of the south road from Iba to San Felipe is passable for carts during the dry season only.

Bangantalinga culvert, double 5 by 4.5 meter, was completed in May, 1915.

Three rectangular culverts of 3.5-meter span each, and one double 3.5-meter, are under construction near Santa Cruz. Since the construction was started great satisfaction has been shown by the northern people.

Requisition for materials for the Subic water supply has been forwarded. It is a gravity system for domestic purposes; estimated cost, ₱8,100. There is a net head of about 25 meters. The work will consist of building a concrete intake and tank and laying 3,500 meters of main and supply pipes.

ZAMBOANGA.

The final survey for the Zamboanga–East Coast Road has been completed as far as Curuan, a distance of 50 kilometers. Grading work at kilometer 13, the end of the present surfaced road, was begun June 21. A 3½-meter gravel surface is being placed as the work progresses. This road when completed will open a vast tract of cultivated land whose only present outlet is by vinta or small launch.

Reinforced-concrete telephone poles for the Zamboanga telephone system have been cast and are being allowed to throughly season before erecting. R. R. Landon, representing the Bryan-Landon, Company of Iloilo, who was awarded the contract for the installation, has arrived upon the ground and the active work of erecting the poles and installing the system will begin about July 15.

Three old wooden culverts in the neighborhood of Zamboanga are being replaced with concrete structures. The wooden superstructure of the Balihuasan Bridge on the San Ramon Road is also being replaced with two reinforced-concrete slabs resting on the old abutments and on one new reinforced-concrete pile bent in midstream. At the San Roque Road crossing of this same river a concrete ford is being constructed, as it is believed the present traffic on this road would not justify the expenditure of the necessary funds for a concrete bridge.

The work of erecting the Zamboanga–Curuan telephone line will be undertaken upon the arrival of special bracket insulators ordered for this project. Poles have already been distributed along the greater portion of the 50 kilometers of line. For portions of this distance, in close proximity to standing timber, sound hardwood poles were obtained for 50 and 60 centavos per pole distributed along the road way.

Cable advices from the United States have been received to the effect that, owing to lack of freight space on the trans-Pacific boats, the shipment of the Zamboanga waterworks and hydroelectric materials will probably be delayed until September. Work on the flume and reservoir will, however, be undertaken within the next few months. Construction work on the extension of the Santa Maria Road to the proposed intake on the Tumaga River has already begun. This road is being constructed primarily as a means of transporting waterworks materials. The road, however, is to be surfaced and when completed will be by far the most scenic automobile road in the province. From the top of the hill near the end of the present Santa Maria Road the new road will descend to the gorge level along the steep hillside on an 8 per cent grade, giving a magnificent view of Pulung Batú and the Tumaga River below.

Work on the Zamboanga port works is practically at a standstill while awaiting approved plans for the pile section of pier. A small amount of dredging is being done at the head of the present wooden pier to give a minimum depth of 26 feet at mean low tide. The newly completed portion of the sea wall and pier, with its ornamental concrete electric light poles, flower urns, and benches, has not only greatly improved the appearance of the sea front, but has also provided the city with an ideal evening resting place and promenade. The Zamboanga pier at 6 p. m. bids fair to rival the Manila Luneta in the near future.

The Santa Maria Canal, a relic of Spanish days and one of the land marks of Zamboanga, has recently been filled between Calle Magay and Calle Felipe II, thus allowing Calle Madrid to be extended to the present market buildings and reclaiming approximately 2,270 square meters of valuable land situated in the most central portion of the city. The canal water for this distance is now carried through a 24-inch concrete pipe. Upon this reclaimed land it is planned to erect modern market tiendas. The portion of the old canal between Calle Felipe II and Calle Voluntarios, which is bordered by magnificent old mantalisay trees, has been converted into a lagoon. Ornamental concrete balustrades carrying electric light posts and flower urns have been constructed at either end, and the canal banks converted into a flowering mass with orchids and other tropical plants.

GENERAL ITEMS.

STUDENT WORKMEN.

In the construction of the Baloc–San Jose Road and the Academic Building at the Central Luzon Agricultural School, Muñoz, Nueva

Students, C. L. A. S., at work on the cut near diversion site, Muñoz communal irrigation system, Nueva Ecija.

Physical culture of the right sort. Students, C. L. A. S., at work on canal extension work, Muñoz communal irrigation system, Nueva Ecija.

Ecija, students have been used on all the work as laborers, carpenters, and masons. The scheme has proved very successful. A regular detail of students is assigned to each piece of work, to stay on the job until they have learned to do that class of work effectively. Each student is thus given a chance to learn mason work and carpenter work in the most practical manner and is also taught how to read plans. In the construction of reinforced-concrete culverts the students are taught not only how to build a culvert, but also how to keep unit costs. When a detail of students has completed one or more culverts they take up the system of unit costs as regular classwork and figure out what each item costs and why, this being a part of the course in arithmetic, and then a new detail is put on with instructions to reduce the cost of certain items which it generally does.

NOTES ON THE PRESERVATION OF FERRIC STRUCTURES.

With very few exceptions, the elements are unstable. Iron in its commercial forms, while not among the least stable of the elements, is by no means a stable element, for it combines readily with various other elements to form compounds which are more stable than pure iron is itself. Of these compounds ferric oxide (Fe_2O_3) commonly known as iron rust, is the one most frequently encountered on iron and steel structures, and the preservation of these structures has, as its principal purpose, the prevention of the formation of this compound.

In regard to the ordinary method by which the iron rust which is found on ordinary structures is formed, there are a number of theories. Two of these, the carbonic-acid theory and the electrolytic theory, seem to be the most generally accepted at the present time. The carbonic-acid theory assumes that iron is attacked by the carbonic acid which is found in ordinary water and that an iron carbonite is formed which, in turn, is changed to ferric oxide by the action of the free oxygen which is also present in ordinary water. The electrolytic theory assumes that, due to a number of causes, differences of electrical potential are set up between the particles of the various substances which are found in ordinary commercial iron and steel, or between the metal and its coatings, and that in the flow of the currents which result the iron is dissolved and an iron hydroxide ($FeOH$) formed which in turn is oxidized to Fe_2O_3.

While these two theories differ greatly in the assumptions which they make as to the methods by which iron rust is formed, they are alike in their assumption that water must be present if the assumed reactions are to take place. Whichever theory is accepted, therefore, the problem of rust prevention will finally resolve itself into a problem of excluding moisture or of preventing the disastrous results which attend its presence. Of the efforts to suppress rusting without the elimination of moisture there are many conflicting opinions, but there can be no doubt whatever that if steel structures could be kept dry there would be no rusting. Of course, it must be understood that water exists in infinitesimal quantities in many places and under many conditions where a superficial examination fails to indicate its presence. But, as even the minutest film of water is capable of performing all of the functions that are required in the bringing about of the disintegration of ferric materials, and as even the water which is held as water of crystallization is also capable of performing this function, it will be seen that a structure to be absolutely insured against deterioration must be absolutely dry, not merely dry enough to satisfy the senses of sight and touch.

As the problem of the protection of ferric structures becomes a problem, either of coating these structures that moisture will be prevented from reaching the metal or of coating them with compounds which will, in some way, prevent or mitigate those activities which are facilitated by the presence of water, a number of distinct systems of protection have been developed. There are four such systems that are well recognized and fairly distinct. First, the ferric material may be covered by means of inert materials that are intended to exclude water as thoroughly as possible. Under this heading may be mentioned the Bower Barf process, tin plating, japans, and ordinary paints. Second, the ferric materials may be covered by some substance which contains active alkalies. Steel imbedded in concrete and pipes coated with asphalts or tar containing lime and cement are illustrations of the use of this method of protection. Third, it is possible to cover iron and steel plates and shapes with some material which is electrically positive to iron and by so doing bring about a condition whereby the covering material will not be deteriorated by any attacks on the combination. Galvanizing is an illustration of this method of preserving iron and steel. Fourth, ferric substances may be covered with some substance that will render them passive. The chromates have a rather remarkable tendency in this direction and zinc chromate is now used with some frequency in connection with other paint pigments to prevent rusting by inducing passivity.

The first of these systems is based solely on an effort to exclude water and the success of any of the processes named in the first system depends on the formation of an impervious coating over a clean dry surface. The second, third, and fourth systems endeavor to exclude as much water as possible, but hope to mitigate the effect of such moisture as does reach the iron or steel. However, so far as the writer has been able to observe, the mitigation is of a very temporary nature. It is undoubtedly true that a zinc covering will, for a time, prevent iron substances from rusting even though the iron is exposed in small areas, but this exposure of the iron results in the rapid deterioration of the zinc and before long the exposed iron surfaces are so large that the protecting influence of the zinc is not sufficient and a pit begins to form. Where steel and iron are imbedded in alkaline substances the alkalinity disappears by the formation of stable compounds. For instance, calcium hydroxide, which protects the steel in concrete, eventually becomes calcium carbonite and loses its protective value almost entirely. Where zinc chromate is used as a paint pigment, its protecting power depends on its solubility and when finally leeched out of the paint film the protective quality of the film is lost, and if the zinc chromate has been an appreciable part of the pigment used, a porous film and the rapid deterioration of the covered metal results.

Engineers must, therefore, face the fact that there is to-day no process known by which any very distinct advantage is certain to be secured from any system which seeks to prevent rusting where moisture is present. This is particularly true in the Tropics where all natural influences tend toward a more rapid deterioration of ferric structures than would be considered normal in temperate climates.

Due to the severe weather conditions in the Philippine Islands, it has been impossible to find a paint that will last more than two or three years, and even the permanency of the protective influence of concrete—a protective influence that engineers in the United States usually assume will last from fifty to one hundred years—is beginning to be doubted. The reason for the short life of reinforced concrete will not be discussed in this connection farther than to say that it is probably due to the fact that all concrete structures erected in this country are exposed to a wet season lasting about six months, and that during this wet season the temperature and the amount of moisture are such that the elimination of the protecting alkalies is probably more rapid than would be expected in the States. Moreover, the protecting alkalies having once been eliminated, the climatic conditions, as to moisture and temperature, are such as to make the rate of the rusting of the imbedded steel much higher than it would be in temperate climates. These same conditions make it very doubtful as to whether zinc chromate will prove advantageous under moist tropical conditions, and it has already been amply demonstrated that galvanized iron is safe only as long as the galvanizing is intact.

For the preservation of exposed ironwork it has always been customary to use paint of one sort or another. These paints are usually composed of a vehicle and a pigment. They must be free from all elements which are deleterious in their effects as for instance, sulphuric acid; they must adhere properly; they must not contain pigments which are likely to react on each other; they must be as permanent as possible and, most important of all, they must be as nearly impervious as possible. Both the vehicle and the pigments must be obtainable in commercial quantities and at prices which are proportionate to their actual values. Tars and asphaltums applied hot are also usually considered as paints, though they do not strictly conform to the general idea of a compound composed of a pigment and a vehicle, but when dissolved in bisulphide or some similar liquid and spread cold are more nearly true paints.

The principal paint pigments are iron oxide, graphite, carbon, the bitumens, zinc oxide, and the leads. To this list may be added the common adulterants which are frequently termed inert pigments and among which may be mentioned carbonite of lime, chalk, whiting, barytes, blank fix, gypsum, feldspar, china clay, kaolin, marl, brick dust, talc, etc. No effort will be made to discuss these pigments and adulterants at length. There are many defenders of all of the pigments and there is a great deal of trade literature defending the merits both of the pigments and of the adulterants. Suffice it to say that in the selection of pigments for ferric paints only those should be chosen which can be relied on to be free from active elements and from water. Thus iron oxide, though it is itself an inert material, usually contains some water of crystallization and almost always contains minute quantities of acids. It is well known that iron ore usually contains more or less sulphur and that roasting does not entirely dispel this sulphur. In fact, even commercial iron and steel in spite of all the heat generated in smelting, contain some sulphur. Analyses of iron pigments usually show not only a trace of sulphuric acid, but also some phosphoric acid and some carbonic acid. Thus, a substance which in itself is wholly inert, may be rendered not only useless, but even positively dangerous as a paint pigment by reason of the impurities which it carries when prepared under ordinary industrial conditions. The same may be said of the carbon pigments. Carbon itself is highly inert, but many of the so-called carbon pigments are only ground soot. As the commoner varieties of fuel contain sulphur, the soot deposited in their combustion usually contains SO_2 which, by the simple process of taking up water, becomes H_2SO_3, an active acid. The reason for the large number of failures where carbon paints have been used on steel structures is, therefore, clear.

Graphites make much better pigments. They are very highly inert, mix well with oil, and spread readily. Owing to the manner in which the beds of natural graphite have been formed even the impurities in the graphite are much more inert than those found in other pigments. Graphite is not well suited for priming-coat work, but for top coats over ordinary exposed steel there is nothing better.

It has never been possible to manufacture reliable paints from the bitumens. It is wholly impossible to eliminate the sulphuric-acid content from the tars, and the asphalts, though much superior to the tars, are not all always pure. Moreover, when applied in liquid form the evaporation of the solvent makes coatings of these materials more porous than they should be, and even when applied hot, films of these materials are by no means as impervious as is commonly supposed.

Zinc oxide is a dangerous pigment for outdoor work because of its tendency to form zinc carbonite, which compound, as it has a volume more than twice as great as the volume of the zinc oxide from which it is formed, causes blistering and peeling of the paint film.

The lead pigments, particularly blue lead and red lead, are valuable pigments for use in the protection of ferric structures, because of the fact that they are manufactured under such conditions that they are insured of having a minimum of dangerous ingredients. Moreover, both of these pigments, as usually sold, are very fine and they both react with the oils in which they are mixed in such a way that they become, in a large sense, an integral part of the paint film. It is doubtless, for this reason, that these two pigments have given unusually satisfactory results. Most of the other pigments are merely imbedded in the oil vehicle, much as stone is imbedded in mortar to make concrete, there being little or no chemical action noticeable.

As to the inert pigments, or more properly the adulterants, it should be sufficient to call attention to the fact that most of them are cheap minerals which are dug out of the ground and roasted for the purpose of driving off the acids and any organic matter which may be present together with the water which they contain. Some of the adulterants are soluble and therefore valueless for the protection of iron surfaces, because as they are leeched from the paint film this film becomes increasingly porous. Some of these pigments are hydroscopic and their very presence in a paint film is an insurance that water will be taken up and retained by the film. In spite of the roasting which is given to these pigments, the acid which they contained when taken from the ground is almost never entirely driven off. Such acid as remains attacks either the vehicle, which it rapidly destroys, or the iron where it causes pitting under the paint film. Moreover, these adulterants, even though carefully roasted, are seldom free from moisture. It does not take much heating to drive off the free water, but as these minerals are dug from the earth, most of them are hydrate compounds and it is much more difficult to drive off the water of crystallization. Gypsum is a very good illustration of an adulterant that, no matter how dry it may have been when it left the factory, is almost never dry when it goes into the paint. Moreover, it constantly attracts water even after it is mixed and spread in place. Last but by no means least, these adulterants are by no means as inert as is commonly supposed. Where they are mixed with each other or with the true pigments mentioned above and then exposed to the weather in thin paint films, all sorts of chemical interactions may take place and, in fact, often do take place, to the very distinct disadvantage of the paint film and consequently to the disadvantage of the structure that the film is intended to protect.

Of the above pigments and adulterants it may be said without danger of serious criticism that red lead, blue lead, and high-grade graphite are the safest pigments to use. They are comparatively inert. They mix well with oil and form as nearly an impervious film as any pigments which are now produced in commercial quantities. All of these pigments are frequently adulterated, but, if purchased from a reliable manufacturer under a guaranty as to their purity, will give better satisfaction than any other pigments that the market now affords. Therefore, it is safe to say that there is no evidence that could warrant an assumption that the present practice of the Bureau of Public Works in using either a red lead or a blue lead priming coat can be improved. Graphites, being more inert that the lead pigments, have many advantages for top-coat work and the exclusive use of graphite paints for this purpose is to be recommended.

For some reason paint chemists and paint manufacturers seem to have given more attention to the question of pigments than they have given to the question of vehicles. This is probably due to an impression that the vehicle is merely a cement which holds the pigment in place and that in some way the pigment is to protect the ferric surfaces while it is thus held in place, an impression that recent paint literature has done much to promote. The writer prefers to consider paint as having many of the characteristics of concrete and of thinking of an ideal paint film as a thin layer of inert and impervious particles held in place by an equally inert and impervious cement. In other words, it is reasonably certain that the graphite particles or the minute flakes of the blue sublimed lead or the minute particles of finely ground red lead are now as nearly inert and impervious as could well be desired. But they are immersed in a matrix of oil which it has been proven time and again is neither inert nor impervious. It would seem, therefore, that any material improvement in the effectiveness of paints must come by the improvement of the vehicle rather than through any improvement of the pigment.

Linseed oil is now and for many years has been the principal vehicle from which paints are manufactured. Chinese wood oil has recently assumed some importance in the paint industry and other oils seem likely to become of commercial importance but no one of these oils is impervious. In fact, a film made from any of these oils, if immersed in water, will add materially to its weight within a very short time and even if only sprinkled with water, as during a rain, will appreciably thicken and appreciably gain in weight. In fact, this phenomenon is so well known that there is really no dispute over it, but should anyone really doubt the absorptive properties of oil films, it is only necessary for him to inspect the paint on a steel bridge after it has been through a month of dry weather and then inspect it again after a day or two of steady rain. The difference in the appearance of the paint film will be so marked that even the most casual observer can detect it.

As water is necessary for the ordinary processes of rusting and as the oil in the paint film is the medium through which much if not most of the water is conveyed to the surface of the iron, it would seem that anything which would result in decreasing the permeability of this part of the paint film would result in materially increasing the protective value of the paint. Something has been done in this direction by mixing various kinds of drying oils and also by adding to the ordinary vehicle a portion of some of the fossil gums, but as yet neither of these ideas seems to have yielded any important results.

The correctness of the assumption that impermeability is the one characteristic which must be more and more sought after can be readily seen by examining the tin-plate industry. Tin is electrically negative to iron and therefore is not a protection to the iron. In fact, its very presence tends to increase the rapidity with which any ferric body in contact with it is destroyed. However, tin is impervious to water and when coated over clean iron or steel in a manner which insures that the coating is continuous and free from pin holes, etc., has been known to last for over a hundred years. In other words, if a paint film could be made as impervious to water as tin is, there is no reason for supposing that it would not protect ferric surfaces from rusting just as well as tin can be made to protect them, but before any such protection is to be secured very marked advances must be made in the selection and preparation of the vehicle.

Though the vehicle is undoubtedly the weakest part of our paints, this should not be taken as license to overlook ordinary precaution in its selection. For ferric paints boiled oil should be used and the lead oils are probably better than other types. Boiled oil should be used because it contains very much less water than is found in the raw oil. Here again we are confronted by the fact that it is very hard to absolutely exclude water from the paint film. Raw oil often contains as much as 8 or 10 per cent of water, and unscrupulous manufacturers sometimes whip in a considerable increase over this amount. Of course, a vehicle containing as much water as this is by no means any more than a moderate hindrance to rusting. Moreover, sulphuric acid is often used in the purification of linseed oil. Such oils may do well enough for house painting, but they are worse than valueless on ferric structures. It goes without saying that there is no process by which all of the sulphuric acid can be removed from the oil and that that part which remains will be effective for the rapid destruction of the paint film or for accelerating the corrosion of the material over which the film is placed.

To sum up, it is safe to say that any engineer who uses red lead or blue lead for priming coats (mixed blue lead being the safer wherever there is any doubt about the ability of the workmen to mix red lead) and covers this with a high-grade graphite can be satisfied that he has selected pigments which are as good as the market affords at the present time. If these pigments are mixed in high-grade, carefully prepared, boiled linseed oil he can be sure that he has a first-class paint. In fact, whatever diversion he makes from this well-established and thoroughly safe procedure must be recognized as either a cheapening of his paint, with the probability that he will secure correspondingly poorer results, or as being for experimental purposes. Naturally there are conditions which do not require expensive paints. This is not intended as indicating a belief that the most expensive paint is necessarily the best paint for all purposes. Where a temporary covering is desired or where special conditions are to be met there are many cheaper pigments from which it will be possible to select those that will, with more or less certainty, meet these special conditions; but for general open-air structural work such as bridges, steel towers, etc., which are exposed to ordinary weather conditions there are no paints now known which are more reliable than the ones above mentioned.

No matter how good the ingredients of a paint may be, and no matter how thoroughly and carefully they have been mixed, they can be and often are rendered almost useless by careless application. In the first place it is absolutely useless to try to stop rusting by the simple process of covering it up. Many people seem to suppose that because ferric oxide is itself inert no damage will be done if rust in place is so covered that it is kept fairly dry. Nothing could be farther from the fact. Ordinary rust is a hydrated ferric oxide. The surface of a steel structure is never so dry but that it is covered by a minute film of moisture. To paint over this film and over the rust that underlies it is to carefully cover up and conceal all of the elements which are necessary for the active destruction of the rusting material. If paint is put on in this way a little whiting will be about as effective as the best paint manufactured. Naturally the proper cleaning of a structure costs a good deal of money, but it can be set down as an indisputable fact that unless a structure is properly cleaned before it is painted, preferably by means of a sand blast, the use of even the best grades of paint that are manufactured will not prevent its rapid destruction.

As has been repeatedly emphasized, paint must be as nearly impervious as possible. In spite of this well-known fact, painters and even engineers often use volatile driers in paints for ferric structures. Boiled oil contains lead or other salts which by their cataulic action cause the oil to absorb oxygen and therefore to dry rapidly. This drying process is not a process of subtraction by evaporation, but a process of addition by oxidation and during the process the oil film increases materially in weight and thickness, but there is nothing in the process which tends to rupture or puncture the film. The use of volatile driers of whatever nature is detrimental to a paint film because their use brings about a condition of drying by subtraction. The film loses in weight an amount equal to the weight of the drier. Such drying is the exact equivalent of boiling down a pot of mush. At first the holes through which the bubbles of gaseous drier escape are closed by the skin tension in the film, but as the film becomes drier the escaping bubbles make holes which are not so closed, with the result that the film is rendered porous and the underlying metal more accessible to attack.

Paints are often applied too thick. If a paint film is too thick it dries on top but remains plastic underneath. In drying from this condition a film is likely to peel, or if subject to any abrasion while in this condition, is easily ruptured. Moreover, two thin coats are better than one thick coat, because the second coat will, to a large extent, correct the deficiencies and inequalities of the first coat. How true this is may be judged from the fact that the Bureau of Standards (see Technologic Paper No. 15) found four coats of paint the minimum that could be depended on to give an impervious film.

Briefly, then, while no paint coat can be considered a permanent protection against rusting it may be confidently asserted that much better results will be secured if high-grade ingredients are used than if no care is taken in the selection of paint materials. As in most affairs, so here; the best is the cheapest in the long run, and this applies to the application of the paint as well as to the selection of its ingredients.

STATEMENT SHOWING SHRINKAGE IN SIZE AND WEIGHT OF SEVERAL PHILIPPINE WOODS.

Through the courtesy of Mr. F. L. Wilson, manager of the Kolambugan Lumber Company, Mindanao, a statement has been furnished with the following tables showing shrinkage in size and weight of certain classes of timbers. During the period covered by this test, extremely dry weather was experienced and it is possible that varied weather would give different results. Mr. Wilson is making a series of tests to determine the effect of wet weather upon these timbers; the result of which we shall endeavor to secure for publication later:

LUMBAYAO.

Date.	Weight.	Length.	Width.	Thickness.
	Kilos.	*Ft. ins.*	*Inches.*	*Inches.*
Jan. 2	22.6	10 0	$12\frac{4}{16}$	1
Jan. 12	18.4			
Jan. 22	17.2	9 $11\frac{5}{8}$	$11\frac{15}{16}$	$\frac{15}{16}$
Feb. 12	16.8	9 $11\frac{5}{8}$	$11\frac{14}{16}$	$\frac{15}{16}$
Feb. 24	16.4	9 $11\frac{5}{8}$	$11\frac{12}{16}$	$\frac{15}{16}$
Mar. 11	16.4	9 $11\frac{5}{8}$	$11\frac{12}{16}$	$\frac{15}{16}$
Apr. 1	16.4	9 $11\frac{5}{8}$	$11\frac{15}{16}$	$\frac{15}{16}$

GUIJO No. 6.

Date.	Weight.	Length.	Width.	Thickness.
	Kilos.	*Ft. ins.*	*Inches.*	*Inches.*
Jan. 2	23.8	10 0	$12\frac{6}{16}$	1
Jan. 12	21.0			
Jan. 22	20.0	10 0	$12\frac{4}{16}$	$\frac{15}{16}$
Feb. 12	19.0	9 $11\frac{5}{8}$	$12\frac{1}{16}$	$\frac{15}{16}$
Feb. 24	18.6	9 $11\frac{5}{8}$	$12\frac{1}{16}$	$\frac{15}{16}$
Mar. 11	18.6	9 $11\frac{5}{8}$	12	$\frac{15}{16}$
Mar. 22	18.6	9 $11\frac{5}{8}$	12	$\frac{15}{16}$
Apr. 1	18.6	9 $11\frac{5}{8}$	12	$\frac{15}{16}$

GUIJO No. 3.

Jan. 2	21.5	9 $11\frac{4}{8}$	$12\frac{1}{8}$	$\frac{15}{16}$
Jan. 12	19.2			
Jan. 22	18.2	9 $11\frac{1}{8}$	12	$\frac{15}{16}$
Feb. 12	17.5	9 $11\frac{1}{8}$	$11\frac{7}{8}$	$\frac{15}{16}$
Feb. 24	17.4	9 $11\frac{1}{8}$	$11\frac{6}{8}$	$\frac{15}{16}$
Apr. 1	17.4	9 $11\frac{1}{8}$	$11\frac{6}{8}$	$\frac{15}{16}$

APITONG.

Jan. 2	20.2	10 0	$11\frac{12}{16}$	$\frac{15}{16}$
Jan. 12	17.2			
Jan. 22	15.3	9 $11\frac{5}{8}$	$11\frac{6}{16}$	$\frac{15}{16}$
Feb. 12	15.0	9 $11\frac{5}{8}$	$11\frac{3}{16}$	$\frac{15}{16}$
Feb. 24	14.3	9 $11\frac{5}{8}$	$11\frac{2}{16}$	$\frac{15}{16}$
Mar. 11	14.2	9 $11\frac{5}{8}$	$11\frac{2}{16}$	$\frac{15}{16}$
Mar. 22	14.2	9 $11\frac{5}{8}$	$11\frac{2}{16}$	$\frac{15}{16}$
Apr. 1	14.2	9 $11\frac{5}{8}$	$11\frac{2}{16}$	$\frac{15}{16}$

TANGUILE.

Jan. 2	17.0	9 $11\frac{4}{8}$	12	$\frac{15}{16}$
Jan. 12	14.4			
Jan. 22	13.0	9 $11\frac{1}{8}$	$11\frac{14}{16}$	$\frac{15}{16}$
Feb. 12	12.0	9 11	$11\frac{11}{16}$	$\frac{15}{16}$
Feb. 24	12.0	9 11	$11\frac{9}{16}$	$\frac{15}{16}$
Apr. 1	12.0	9 11	$11\frac{9}{16}$	$\frac{15}{16}$

RED LAUAN.

Jan. 2	10.5	9 $11\frac{4}{8}$	$12\frac{1}{8}$	$\frac{15}{16}$
Jan. 12	8.8			
Jan. 22	8.4	9 $11\frac{1}{8}$	$11\frac{7}{8}$	$\frac{15}{16}$
Feb. 12	8.2	9 $11\frac{1}{8}$	$11\frac{6}{8}$	$\frac{15}{16}$
Feb. 24	8.0	9 $11\frac{1}{8}$	$11\frac{6}{8}$	$\frac{15}{16}$
Apr. 1	8.0	9 $11\frac{1}{8}$	$11\frac{6}{8}$	$\frac{15}{16}$

GUIJO.

Jan. 18	23.0	10 $2\frac{3}{4}$	$11\frac{11}{16}$	1
Jan. 30	20.5	10 $2\frac{3}{4}$	$11\frac{8}{16}$	$\frac{15}{16}$
Feb. 15	20.0	10 $2\frac{3}{4}$	$11\frac{5}{16}$	$\frac{15}{16}$
Mar. 1	19.6	10 $2\frac{3}{4}$	$11\frac{4}{16}$	$\frac{15}{16}$
Mar. 11	19.4	10 $2\frac{3}{4}$	$11\frac{4}{16}$	$\frac{15}{16}$
Mar. 31	19.4	10 $2\frac{3}{4}$	$11\frac{4}{16}$	$\frac{15}{16}$

LAUAN, WHITE.

Jan. 18	13.5	10 $2\frac{3}{4}$	$12\frac{7}{16}$	1
Jan. 30	10.5	10 $2\frac{3}{4}$	$12\frac{3}{16}$	1
Feb. 15	10.0	10 $2\frac{3}{4}$	$12\frac{2}{16}$	$\frac{15}{16}$
Mar. 11	10.0	10 $2\frac{3}{4}$	$12\frac{2}{16}$	$\frac{15}{16}$

TABIGUE.

Jan. 18	24.0	10 $2\frac{3}{4}$	$12\frac{8}{16}$	1
Jan. 30	20.0	10 $2\frac{3}{4}$	$12\frac{7}{16}$	$\frac{15}{16}$
Feb. 15	19.8	10 $2\frac{3}{4}$	$12\frac{6}{16}$	$\frac{14}{16}$
Mar. 1	19.6	10 $2\frac{3}{4}$	$12\frac{5}{16}$	$\frac{14}{16}$
Mar. 11	19.6	10 $2\frac{3}{4}$	$12\frac{5}{16}$	$\frac{14}{16}$

NOTE.—Boards were stacked on end so that air could reach all sides.

FINANCIAL.

APPROPRIATIONS AND ALLOTMENTS, FISCAL YEAR 1915.

Additional to the special allotments previously reported in April 1, 1915, issue of the QUARTERLY BULLETIN, from Act No. 1988, the following allotments have been made:

Cavite	₱19,000.00
Tayabas	19,000.00
Previously reported	443,000.00
Balance unallotted	19,000.00
Total	500,000.00

LOANS FOR ROADS, BRIDGES, SCHOOLS, MARKETS, ETC., FROM APRIL 1, 1915 TO JUNE 30, 1915.

Province and project.	Acts Nos.			Total.
	1729.	1749.	2083.	
Ambos Camarines: Construction of bridges and culverts on the Pili-Tigaon Road			₱150,000.00	₱150,000.00
Bulacan:				
Malolos market		₱19,000.00		19,000.00
Hagonoy market		7,000.00		7,000.00
Hagonoy municipal building		30,000.00		30,000.00
Cagayan: Camalaniugan municipal building			4,000.00	4,000.00
Iloilo: Dingle Central School			5,000.00	5,000.00
Laguna: San Pedro market		29,000.00		29,000.00
La Union: San Fernando Central School	₱7,500.00			7,500.00
Leyte: Tacloban market			4,000.00	4,000.00
Nueva Ecija:				
Guimba market	12,000.00			12,000.00
San Isidro market	10,000.00			10,000.00
Occidental Negros:				
Bacolod market	25,000.00			25,000.00
Maao market (Bago)	15,000.00			15,000.00
Rizal:				
Provincial High School			10,000.00	10,000.00
San Juan del Monte market		10,000.00		10,000.00
Tarlac: Camiling Bridge	66,000.00			66,000.00
Zambales: Subic waterworks system			8,100.00	8,100.00
Zamboanga: Zamboanga waterworks system			175,000.00	175,000.00
Total	135,500.00	95,000.00	356,100.00	586,600.00

CIVIL ENGINEERS.

By GEORGE FITCH.

A civil engineer is a quiet man with a thick coat of sunburn, who spends his time revising climates, editing the landscape, and training up rivers into lives of usefulness.

In order to do this the civil engineer does not tear the earth wide open with 100-ton spades or perform other feats of strength. He is usually of ordinary size and if he only used his own hands he could not push around a small creek, let alone a river. The civil engineer does not rely on muscle. When he desires to move a mountain or wipe out a few hundred square miles of desert with a dam, he takes his logarithm book and retires to a quite spot where he fills an acre of brown paper full of figures. At the end of six months he emerges with a tired air and a carload of blueprints and motions to the steam-shovels to come on up and get busy.

The civil engineer is not generally known. This is because he cannot often be found on the street corners or in the clubs or in the act of decorating grand opera with a vast white shirt front. He usually lives in the wilderness in hip boots and a last week's shave. After the ordinary man has lived in a wilderness for a few years his mother wouldn't know him. But after an engineer has lived in a wilderness the same length of time its mother wouldn't know it. The engineer is continually editing and revising nature, rearranging mountains, and making rivers back up and go the other way. He is as restless and unsatisfied with the way things look as the woman who always rearranges the parlor furniture while her husband is away so that he may fall over it when he comes home in the dark and receive a pleasant surprise.

The civil engineer has hung railroads on mountain sides, run tunnels under city streets, made oceans shake hands, harnessed up Niagara Falls, made parks out of the western deserts, and has put a reverse gear in the Chicago River. Some day he will begin experimenting with the earth's orbit and we may yet have Christmas at the Fourth of July and a weekly comet service to Mars–who knows? Logarithms and a square jaw working harmoniously can do almost anything.

APPENDIX A.

CIRCULAR LETTERS ISSUED BY THE CONSTRUCTING DIVISION FROM APRIL 1, 1915, TO JUNE 30, 1915.

MANILA, *June 24, 1915.*

Constructing Division Circular No. 155.

SIR: Your attention is invited to the inclosed copy of the grading rules of the Bureau of Forestry applying to the purchase and sale of native lumber by all departments of the Philippine Government.

These grading rules should be made a part of your office records, and you are directed to carefully and thoroughly acquaint yourself with them, and also take suitable action to have all your subordinates, whether inspectors or construction foremen, thoroughly familiar with these rules for grading lumber. A consistent and rigid knowledge and enforcement of them should be insisted upon by your office in all construction work in your district.

For the Director:

C. E. GORDON,
Acting Chief Constructing Engineer.

To all DISTRICT ENGINEERS.

PROPOSED GRADING RULES APPLYING TO THE PURCHASE AND SALE OF NATIVE LUMBER BY ALL DEPARTMENTS OF THE PHILIPPINE GOVERNMENT.

I. INSTRUCTION.

The following grading rules shall be applied in the inspection of all native lumber sold, purchased, or used by any department of the Philippine Government. They shall also govern the inspection of any lumber sold by local dealers for export or for local use, if such lumber, by the terms of the contract, is to be inspected by an official inspector furnished by the Government of the Philippines. In such cases, copies of these rules will be supplied to both contracting parties. In case foreign purchasers wish to make special stipulations for grading lumber which is to be put to uses requiring special qualifications, provided such stipulations are agreed to by the local dealers furnishing the lumber and provided the Bureau of Forestry finds nothing unreasonable in them, the official inspectors shall be guided by these stipulations in making their inspections. In such cases, the conditions of the contract must be clearly understood between the three interested parties—that is, the two contracting parties and the Bureau of Forestry—before the latter will authorize any inspection. For the present, such inspections will be made only at or near Manila; for points other than Manila, and an inspector may be detailed in special cases, provided one is available.

The exact grade must be specified in every contract, order, or requisition for lumber. Such a term as "first-class lumber" has no specific meaning and no attention will be paid to this or like terms. If no grade, as defined in the following rules, is specified, the purchaser or requisitioner will have no recourse but to accept lumber as furnished, provided it be not of a grade lower than merchantable No. 1.

It is always to be recommended that requisitioners and purchasers, in addition to specifying the grade required, also note to what use the lumber is to be put, as an inspector can apply the grading rules more intelligently when he knows the intended use of the lumber he is inspecting.

Lumber in the rough must be accepted as grade and not subject to any change of grade resulting from milling subsequent to inspection.

II. GENERAL INSTRUCTIONS.

STANDARD SIZES.

The English system of measurement will be used in all transactions in manufactured lumber.

[NOTE.—Dimensions should be indicated as follows: First, thickness in inches; second, width in inches; third, length in feet. Example: 2 in.×18 in.×22 ft., or 2″×18″×22′. When it is understood that all dimensions are given in this order, the abbreviations or signs for the words "inches" and "feet" are frequently omitted, thus: 2×18×22.]

The following are to be considered standard sizes, and to such the rules will be applied strictly. Lumber of extraordinary lengths and widths for special uses will be inspected largely with a view to its fitness for the use for which it is intended:

1″×4″, 6″, 8″, 10″, 12″—12′ to 24′.
2″×3″×4″, 8″, 10″, 12″—12′ to 24′.
3″×4″, 6″, 8″, 10″, 12″—12′ to 32′.
4″×4″, 6″, 8″, 10″, 12″—12′ to 32′.
6″×6″, 8″, 10″, 12″—12′ to 36′.
8″×8″, 10″, 12″—12′ to 36′.
10″×10″, 12″—12′ to 36′.
12″×12″—12′ to 36′.

It is understood that these sizes apply to unseasoned lumber and are subject to a certain amount of shrinkage in the process of seasoning.

In all lumber under 1 inch in thickness each square foot of surface is counted as 1 board foot; in lumber every 1 inch in thickness, the measurement in board feet is the actual volume of the piece.

Surfaced lumber in sizes less than 4 inches in thickness is finished ⅛ inch less than the nominal size for each side surfaced; in sizes 4 inches and over in thickness, ¼ less than the nominal size for each side surfaced; tongue-and-groove stuff, shiplap, and rustic siding are finished; in 4-inch widths or less, ⅜ inch less than nominal width and ⅛ inch less than nominal thickness; 6 and 8 inch widths, ⅛ inch less than nominal width. Tongue-and-groove and rustic are usually surfaced on one side only; when surfaced two sides on special order, they will be ¼ inch less than nominal thickness.

Molding made from standard sizes of rough stock will run about ¼ inch less in width and thickness than the nominal rough size.

An inspector cannot be held responsible for the degree of seasoning of any lot of lumber, as no superficial examination can determine the amount of moisture in timber; nor can he be held responsible for shrinkage, splitting, or checking due to seasoning subsequent to inspection.

Torn and slivered grain in finished lumber, caused by planing, will reduce lumber one grade regardless of all other qualifications.

When any species of wood named in Classes A, B, and C is intended to be used for some purpose other than those indicated in the names of the classes, it will be graded according to the rules of the class to which it is transferred.

In interpreting the grading rules, the appendix shall guide the inspector in applying the rules to any given species, the notes in the appendix being in the nature of modifications intended to facilitate or regulate the application of the rules to a given species according to its individual peculiarities.

III. DEFINITIONS.

The following terms, where used in the rules and appendix, will be understood as here defined:

Checks (or heart cracks).—Cracks passing radially through or near the heart of the log and sometimes extending to the outside; in sawn timber not always to be distinguished from shakes and splits.

Corner.—One of the angles dividing the edges and faces of a board or two surfaces of a dimension timber.

Edge.—The narrow surface of a board.

Face.—In rough boards, or in boards surfaced on both sides, either of the two board surfaces of a board; but when only one side is surfaced, "face" is understood to mean the surfaced side.

Heart-cracks. (See Checks.)

A *round knot* is one which is sawn through at right angles or nearly so, showing as a circle or oval on the surface.

A *spike knot* is one which is sawn through lengthwise, showing as a more or less broad streak across the surface.

Mill-run.—Lumber as sawn from logs, without grading, but excluding slabs.

Pinholes.—Holes made by small boring beetles, usually about the diameter of the head of a common pin.

Pitch pockets; pitch seams.—Cavities caused by knots, shakes, checks, etc., more or less completely filled with resin.

Random lengths.—This expression means that a lot of lumber may consist of any and all standard lengths at the option of the seller; in addition, odd lengths may be admitted when explicity stated in contract.

Random widths.—Has the same application as *random lengths.*

Sapwood.—Sound sapwood is sapwood free of wormholes, rot, and checks.

Bright sapwood is sound sapwood free of any stain or discoloration, it being understood that superficial discoloration caused by exposure, and which can be removed by one cut of the planer, is not considered a defect.

Season checks (or surface checks.)—Superficial cracks caused by shrinkage of timber on the surface, due to rapid drying, especially when fresh-sawn lumber is exposed to the weather.

Shakes.—Circular cracks sometimes existing in the living tree, sometimes caused by shocks received in falling; they may sometimes plainly appear as shakes in the sawn lumber, but sometimes are not to be distinguished from checks and splits, according to the way the lumber is sawn from the log.

Splits.—Cracks in the ends of boards of dimension timbers, caused by rapid drying at the ends, or by rough usuage in milling and transporting.

Surface.—Any side of a dimension timber.

Surface checks. (See Season checks.)

Wane.—A beveled edge of a board or plank as sawn from an unsquared log, the bevel being caused by the curvature of the log.

Wormholes.—Holes ranging from ⅛ to ½ inch.

IV. ABREVIATIONS OF TECHNICAL TERMS IN COMMON USE.

S 1 S.—Surfaced—that is, machine planed, on one side; always understood, in any lumber not of square cross section, to mean one of the two board faces.

S 2 S.—Surfaces on two sides; always understood to mean the two board faces.

S 3 S.—Surfaced on three sides; always understood in practice to mean one face and both edges. (See S 2 S and 1 E.)

S 4 S.—Surfaced on four sides.

S 1 E.—Surfaced on one edge.

S 2 E.—Surfaced on both edges.

S 1 S & 1 E.—Surfaced on one face and one edge.

S 2 S & 1 E.—Surfaced on two faces and one edge.

T & G.—Tongue and grooved; understood in practice to be S 1 S.

T & G., S 2 S.—Tongue and grooved and surfaced both sides.

T & G & E.—Tongue and grooved and beaded; the bead is made on the tongued edge and a chamfer on the grooved edge to meet bead of next piece; understood to be surfaced and beaded one side only.

T & G & B., S 2 S.—Tongue and grooved and beaded one side, opposite side surfaced.

T & G & B 2 S.—Tongue and grooved and beaded and surfaced both sides.

T & G., B & C. B.—Tongue and grooved, beaded and center beaded; understood to be S 1 S; further operations are indicated as for T & G & B.

V B.—V-beaded—that is chamfered along both edges to form a V groove.

B. M.—Board measure. Example 2,600 ft. B. M.

Lin, ft.—Lineal feet of length, regardless, of width and thickness.

Sup. ft.—Superficial feet—that is, square feet of surface regardless of thickness.

M.—One thousand (understood to mean 1,000 board feet, or 1,000 feet, B. M.)

V. GRADING RULES.

CLASS A (LIGHT CONSTRUCTION TIMBERS).

All lauans, tanguile, lumbayao, apitong, nato, palosapis, and similar soft and nondurable timbers.

Clear.—Shall be sound lumber well sawn on at least three sides, free of wane, large or loose round knots, of spike knots, rot or dry rot, and of pinholes, wormholes, and shakes or checks when shown on more than one side, except in lumber 2 inches or less in thickness, which must be free of shakes or checks on both faces. Clear lumber will allow:

1. In 2 inches or less in thickness; bright sapwood showing only on one face and one edge and not exceeding 10 per cent of the area of the face; pinholes showing on one face only not exceeding six to the square foot; sound round knots not over 1 inch in diameter and far enough apart to cut 3 feet clear between any two knots; splits not to exceed 1 foot in length in 16-foot boards, other lengths in proportion; variations in sawing not to exceed 1/16 inch per inch of thickness nor ⅛ inch per foot of width; superficial season checks, unless sufficiently severe to impair strength or appearance of the piece, not to be considered a defect.

2. Over 2 inches in thickness; sound sapwood on any two faces not to exceed 10 per cent of the area of two faces affected; pinholes on two faces; sound round knots as in 2-inch lumber; variations as in 2-inch lumber; superficial season checks as in 2-inch lumber.

Select.—Shall be sound lumber, well sawn, free of loose or rotten round knots, of spike knots, rot or dry rot, and of sapwood, shakes, checks, and splits, except as specified below. Select lumber will allow:

1. In lumber 2 inches or less in thickness; sound sapwood on both faces not to exceed 20 per cent of the area of one face and 10 per cent of the opposite face; pinholes not to be considered a defect unless so numerous as to affect seriously the strength or appearance of the piece; sound round knots not over 2 inches in diameter; wane on one corner only, not to exceed ½ inch in width nor ⅙ of the length of the piece; splits as in "clear;" variations in sawing not to exceed ⅛ inch per inch of thickness nor ¼ inch per foot of width; superficial season checks as in "clear."

2. Over 2 inches in thickness; sound sapwood not to exceed 20 per cent of the cross section of the piece; sound round knots or sound spike knots of any size, wane on not more than two corners, not exceeding 1 inch in width on any face nor one-sixth the length of the piece; variations in sawing not to exceed ¼ inch per 2 inches of thickness or 12 inches of width; shakes or checks, if not showing on more than one face nor more than 1 inch in depth; splits as in "clear;" pinholes and superficial season checks not considered defects, unless seriously impairing strength or appearance of piece.

Merchantable.—Shall be sound lumber, free from defects not specified below, and suitable for general ordinary construction. In this grade mixed species will be admitted, provided the order, contract, or requisition states nothing to the contrary and provided there is no admixture of species inferior in strength or durability to the ordinary kinds of lauan. Merchantable lumber will allow:

1. In 2 inches or less in thickness; sound sapwood without limit; sound knots of any size; shakes or checks if not large enough to impair seriously the strength of the piece; wane on not more than two corners, not exceeding 1½ inches in width on any one face, not exceeding one-fourth the length of the piece; splits not to exceed one-eighth the length of the piece; pinholes or wormholes if not sufficiently numerous to impair seriously the strength of the piece; variations in saving as in "select."

2. More than 2 inches in thickness; sound sapwood without limit; sound knots of any size; shakes or checks not extending clear through the piece and not affecting seriously its strength; wane as in 2-inch lumber; splits as in 2-inch lumber; pinholes or wormholes as in 2-inch lumber; variations in saving as in "select."

CLASS B (HEAVY CONSTRUCTION TIMBERS).

Shall include alupag, alupag-amo, amugis, anubing, aranga, bacauan, banaba, bansalaguin, batitinan, betis, binggas, calamansanay, calumpit, catmon, dalindingan, dalinsi, duñgon, guijo, ipil, liusin, macaasim, malugay, mangachapuy, molave, naring, pagatpat, palo maria, sacat, sasalit, tuai, yacal, and such other woods as, from their mechanical properties and durability, may be indicated for heavy construction *clear.*

Shall be sound lumber, well sawn on at least three sides, free of wane, large or loose round knots and spike knots, rot or dry rot, and of pinholes, wormholes, shakes, and checks when shown on more than one side, except in lumber 2 inches or less in thickness, which shall be free of shakes or checks on both faces. Clear lumber will allow:

1. In lumber 2 inches or less in thickness; bright sapwood showing on only one face and one edge and not exceeding 10 per cent of the area of the face; pinholes showing on one face and not exceeding six to the square foot; sound round knots not over 1 inch in diameter and far enough apart to cut 3 feet clear between any two knots; splits not to exceed 1 foot in length in 16-foot board, other lengths in proportion; variations in sawing not to exceed 1/16 inch per inch of thickness nor ⅛ inch per foot of width; superficial season checks, unless sufficiently severe to impair materially the strength or appearance of the piece.

2. In lumber over 2 inches in thickness; sound sapwood on any two faces, not to exceed 10 per cent of the area of the faces affected (except as specified for certain species in appendix); pinholes on two faces; wormholes on two faces, not to exceed one to every 6 square feet of surface of faces affected (except as specified for certain species in appendix); sound round knots as in 2-inch lumber; variations in sawing as in 2-inch lumber; season checks as in 2-inch lumber.

Selects.—Shall be sound lumber, well sawn, free of loose or rotten round knots or spike knots, of rot or dry rot, and of sapwood, shakes, or checks except as specified below. Select lumber will allow:

1. In lumber 2 inches or less in thickness; sound sapwood on both faces, not to exceed 5 per cent of the area of one face nor 15 per cent of the reverse (except as specified in appendix); pinholes, unless materially affecting the strength or appearance of the piece; sound round knots not over 2 inches in diameter; wane on one corner, not to exceed ½ inch in width nor one-sixth of the length of the piece (except as specified in appendix); splits as in *clears;* variations in sawing not to exceed ⅛ inch per inch in thickness nor ¼ inch per 12 inches of width; superficial season checks as in *clears.*

2. In lumber over 2 inches in thickness; sound sapwood not to exceed 20 per cent of the cross section of the piece (except as specified in appendix); sound round or spike knots; wane on two corners, not exceeding 1 inch in width on any face nor one-sixth the length of the piece (except as in appendix); variations in sawing not to exceed ¼ inch per 2 inches of thickness or per 12 inches of width; shakes or checks if not showing on more than one face nor more than 1 inch in depth; splits as in *clears;* pinholes and superficial season checks if not materially impairing the strength or appearance of the piece.

Merchantable No. 1.—Merchantable lumber shall be sound, free from defects not specified below, and suitable for general strong construction, will allow:

1. In lumber of 2 inches or less in thickness, sapwood without limit except as in appendix; sound knots as in Class A; shakes or checks as in Class A, except as in appendix; wane as in Class A, except as in appendix; splits as in Class A; pinholes and wormholes as in Class A, except as in appendix; variations in sawing as in Class A.

2. Over 2 inches; sound sapwood as in Class A, except as in appendix; knots, shakes, or checks as in Class A; wane, splits, and pinholes or wormholes as in 2-inch lumber; variations in sawing as in Class A.

Merchantable No. 2.—Any lumber not coming up to requirements of merchantable No. 1, but still fit for rough or temporary construction purposes, box lumber, for lumber, etc.

CLASS C (FURNITURE AND INTERIOR FINISH WOODS).

Shall include acle, acleng-parang, banuyo, batete, baticulin, bitanhol, bolongeta, calantas, camagon, curly calantas, dao, ebony, lanete, malacadios, narra, supa, piagao, tabigi, tindalo, tucan-calao, and any woods of Classes A and B when used for the above purposes.

Clears.—Shall be sound lumber; well sawn on at least three sides; free of wane (except as in 2), of loose or rotten knots, rot or dry rot, and of pinholes, wormholes, shakes, and checks showing on more than one side, except in lumber 2 inches or less in thickness, which shall be free of shakes and checks on both faces. Clear lumber will allow:

1. In 2 inches or less in thickness; no sapwood in any species having sapwood distinctly inferior to heartwood (see appendix); no pinholes; no wormholes, sound round knots not exceeding 1 inch in diameter and not to exceed one to every 4 square feet of surface, except clusters of sound small knots which are allowed without limit, provided they do not affect the strength of the piece; splits not to exceed 1 inch in length to each foot of length of the piece; no wane; variations in sawing not to exceed 1/16 inch per inch of thickness nor ⅛ inch per foot of width; no shakes or heart checks; superficial season checks, unless sufficiently numerous or deep to affect seriously the strength or appearance of the piece.

2. Over 2 inches in thickness; no sapwood in any species having sapwood distinctly inferior to heartwood; pinholes or wormholes on one surface; sound knots not exceeding 1½ inches in diameter and clusters of small knots, provided neither seriously impairs the strength of the piece; splits not to exceed 1 inch in length to each foot of length of the piece; shakes of heart checks on one face, provided they do not extend through more than one-fourth of the thickness nor more than one-eighth of the length of the piece; variations in sawing not to exceed 1/16 inch per inch of thickness nor ¼ inch per foot of width; superficial season checks as in 1-inch lumber; wane on one edge only, not to exceed 1 inch in width on either surface affected, nor one-fourth the length of the piece.

Selects.—Select lumber shall be sound; well sawn on at least three sides; free or large, loose, or rotten knots, rot or dry rot, and of pinholes, wormholes, shakes, and checks, except as specified below. Select lumber will allow:

1. In 2 inches or under; sapwood on one face not to exceed 10 per cent of the area of the face; pinholes or wormholes on one face only; sound knots not exceeding 1½ inches in diameter and clusters of small knots, provided neither seriously impairs the strength of the piece; splits not to exceed 1 inch in length for each foot of length of the piece; variations in sawing not to exceed ⅛ inch per inch of thickness nor ¼ inch per foot of width; shakes or heart checks on one face only not to exceed one-fourth of the thickness nor one-eighth of the length of the piece; wane on one face only, not to exceed in width the thickness of the piece, nor in length one-fourth the length of the piece; season checks on both faces, if not sufficiently numerous or deep to affect seriously the strength or appearance of the piece.

2. Over 2 inches: Sapwood on one edge and one face only not to exceed 10 per cent of the two surfaces affected; pinholes and wormholes on two adjacent surfaces; sound knots not to exceed 2 inches in diameter; splits not to exceed 1 inch in length per foot of length of the piece; shakes and heart checks on two adjacent surfaces, provided they run approximately parallel to the edges and do not exceed one-fourth of the thickness nor one-fourth of the length of the piece; wane on one edge only, not to exceed 1½ inches in width on either face affected, nor one-fourth of the length of the piece; variations in sawing not to exceed 1/16 inch per inch of thickness nor ¼ inch per foot of width.

Merchantable.—Merchantable lumber shall be sound, well sawn on three sides, free from defects except as specified below. Merchantable will allow:

1. In 2 inches or less in thickness: Sound sapwood on one face only, not to exceed 20 per cent of the area of the face; pinholes and wormholes on one face; sound knots or clusters of small knots, shakes, and heart checks on one face only; splits not to exceed 1 inch in length per foot of length of the piece; wane on one edge only not to exceed one-fourth the width of the piece nor one-third the length of the piece; superficial season checks not a defect; variations in sawing not to exceed ⅛ inch per inch in thickness nor ¼ inch per foot of width.

2. Over 2 inches in thickness: Sound sapwood on two sides not to exceed 20 per cent of either face (except as specified in appendix); sound knots of any size, provided they do not materially impair the strength of the piece; shakes and checks, if approximately parallel to edges of piece and of a depth not exceeding one-half its thickness; wane on not more than two edges not to exceed in width one-fourth of any side affected; splits not to exceed in length 1 inch for every foot of length of the piece; pinholes not considered a defect; wormholes not considered a defect, unless seriously impairing the strength of the piece; variations in sawing not to exceed ¼ inch in the thickness nor ½ inch in the width of the piece.

VI. APPENDIX.

Acle.—Rules as to sapwood must be observed very strictly in grading acle.

Acleng-parang.—Same as acle.

Agoho.—Sapwood practically same as heartwood; in large-dimension stuff especially, sapwood need not be considered in grading.

Almon.—Sapwood not to be considered, except in "clear" and "select" grades.

Alupang.—Sapwood of good quality, admissible without limit, except in "clear" grade.

Amuguis.—Rules as to sapwood to be applied strictly.

Anubing.—Rules as to sapwood to be applied very strictly.

Apitong.—Rules as to sapwood to be applied very strictly only in "clear" and "select."

Pitch pockets and pitch seams are very common in this wood. "Clears" will not allow pitch pockets and pitch seams; "selects" will allow pitch seams not over ⅛ inch wide not over 6 inches long, not deeper than one-fourth the thickness of the piece, and there shall not be more than four such seams in a piece 16 feet in length. "Merchantable" will allow pitch seams not over ¼ inch wide, not longer than one-third of the length nor deeper than one-half the thickness of the piece. One such pitch seam or its equivalent allowed in each piece, provided that such seam, or several small seams, run approximately parallel to the edges of the pieces.

Aranga.—Sapwood not a defect.

Bacauan.—Rules as to sapwood to be applied strictly.

Bansalaguin.—Sapwood not a defect.

Banuyo.—Rules as to sapwood to be observed very strictly.

Batete.—Same as banuyo.

Baticulin.—Regulations regarding sapwood to be interpreted liberally except when uniformity of color is necessary.

Batino.—Sapwood not a defect.

Batitinan.—Regulations regarding sapwood to be observed strictly.

Betis.—Sapwood not a defect.

Binggas.—Sapwood not a defect.

Bitanhol.—Regulation regarding sapwood to be observed strictly.

Bolongeta.—When used for ornamental furniture, inlaying, etc., sapwood to be excluded strictly according to rules, unless explicitly admitted by terms of requisition or contract; when used for construction, unlimited sapwood not a defect.

Calamansanay.—Sapwood not a defect.

Calantas.—According to rule.

Calumpit.—According to rule.

Camagon.—Same as bolongeta.

Catmon.—Sapwood not a defect.

Dungon.—When used in contact with ground or much exposed to elements, rules regarding sapwood to be very strictly observed.

Dungon-late.—Same as dungon.

Ebony.—Black heartwood only to be admitted, unless terms of contract or requisition explicitly admit sapwood.

Guijo.—According to rule.

Ipil.—Sapwood very perishable, rules to be observed very strictly.

Lanete.—Sapwood no defect. This wood is much subjected to staining. Stained or "blue" wood not to be admitted in "clears" or "selects."

Lauan, white.—According to rule.

Lauan, red.—This wood has often a very light, soft, and punky heart which must be excluded from "clears" and "selects," and from "merchantable" in so far as it impairs perceptibly the strength of the piece. Sapwood according to rule.

Lumbayao.—Same remarks as lauan, red.

Macaasim.—According to rule.

Malacadios.—Sapwood no defect, unless unformity of color is desired.

Malugay.—Rules regarding sapwood to be observed strictly.

Mancono.—Sapwood so small as to be negligible.

Mangachapuy.—Rules in regard to sapwood to be strictly observed.

Molave.—In molave all lengths from 6 feet up will be considered stock sizes. Molave being a tree with a generally short and very irregular trunk, and the timber being most generally used for structural purposes, where appearance is to be considered less than strength, the rules regarding wane may be interpreted very liberally. The sapwood is small and but little inferior to the heartwood and need not be considered in grading. Large wormholes are common in molave, but generally very few in any one log; if lumber is otherwise up to grade, large wormholes are not considered a defect unless so grouped as materially to weaken the piece.

Narra.—All lengths from 6 feet up will be considered stock lengths. Rules as to wane and sapwood as to very strictly observed.

Nato.—Sapwood but little inferior to heartwood; rules to be interpreted liberally.

Pagatpat.—Rules regarding sapwood to be observed strictly in "clears" and "selects."

Palo maria.—Rules regarding sapwood to be strictly observed.

Sasalit.—Sapwood small and scarcely inferior to heartwood.

Supa.—Rules regarding sapwood to be strictly observed.

Tanguile.—Rules regarding sapwood to be strictly observed.

Tindalo.—Rules regarding sapwood to be very strictly observed.

Tuai.—Rules regarding sapwood to be strictly observed.

Tucang-calao.—Sapwood small and but very little inferior to heartwood.

APPENDIX B.

AUTOMOBILES REGISTERED IN THE AUTOMOBILE DIVISION, BUREAU OF PUBLIC WORKS, FROM JANUARY 1 TO JUNE 30, 1915.

Registry No. and type.	Owner's name and address.
3473. Automobile	Basilio C. Santos, San Miguel de Mayumo, Bulacan.
3474. do	Ernest Hinds, No. 3 Military Plaza, Manila.
3475. do	Eduardo Escudero, Bulan, Sorsogon.
3476. do	Luis R. Yangco, 628 Herran, Malate, Manila.
3477. do	Tomas de Jesus, Atimonan, Tayabas.
3478. do	Eladio Lopez, Atimonan, Tayabas.
3479. do	American Hardware and Plumbing Co., Manila.
3480. do	Do.
3481. do	Do.
3482. do	Bureau of Public Works, Manila.
3483. do	Antonio R. Roxas, 231 Gral. Solano, Manila.
3484. do	Mariano A. Locsin, Daraga, Albay.
3485. Cancelled.	
3486. Automobile	Levy Hermanos, Manila.
3487. do	Romana Arambulo, 534 Ronquillo, Manila.
3488. do	Frank D. Ely, Fort McKinley, Rizal.
3489. do	Moises Guevara, 941 Juan Luna, Manila.
3490. do	Mrs. G. Grant, 1250 del Pilar, Manila.
3491. do	M. R. Lacson, Talisay, Occidental Negros.
3492. do	Bonifacio Vistant, 411 Bermuda, Manila.
3493. do	Chas. H. Errington, Corregidor Island, P. I.
3494. do	Hermenegildo Villanueva, Bais, Occidental Negros.
3495. do	Mrs. C. Heffting, care of Heffting House, Manila.
3496. do	Col. Charles M. Gandy, 10 Military Plaza, Manila.
3497. do	Zacarias Villamiel, Atimonan, Tayabas.
3498. do	Leo Rosenthal, Manila Hotel, Manila.
3499. do	Eustaquio San Juan, 470 Sulucan, Manila.
3500. do	B. R. Campbell and J. A. McGrath, McKinley, Rizal.
3501. do	F. Kariacos, Tagbilaran, Bohol.
3502. do	Philippine Sugar Development Co., Calamba, Laguna.
3503. do	Do.
3504. do	Mrs. Hubert T. Fox, 46 Looban, Manila.
3505. do	Alejo Imco, Malabon, Rizal.
3506. do	Pantaleon E. del Rosario, Cebu, Cebu.
3507. do	Quartermaster Corps, Manila.
3508. do	Do.
3509. do	H. E. Case, 10 Hipodromo, Manila.
3510. do	W. H. Winters, Legaspi, Albay.
3511. do	Melecio Severino, 219 Real, Walled City, Manila.
3512. do	Generoso Reyes, 1004 Oroquieta, Manila.
3513. do	Bureau of Agriculture, Manila.
3514. do	Roy J. Berry, 223 Gral. Luna, Manila.
3515. do	Arthur C. Grilk, 710 Pennsylvania, Manila.
3516. do	Miguel Irisarry, 600 L. Guerrero, Manila.
3517. do	Bazar Velasco, & Co., 130 Nueva, Manila.
3518. do	Philippine Vegetable Oil Co., Manila.
3519. do	Chan Cho Hao, 48 Barraca, Manila.
3520. do	José Albert, 500 Zurbaran, Manila.
3521. do	Augusto Anguita, 239 Real, Walled City, Manila.
3522. do	Aurea Tanchiong, 268 Moriones, Manila.
3523. do	L. A. Barretto, 213 San Antonio, Manila.
3524. do	Mrs. E. P. Thibault, 1269-A. M. H. del Pilar.
3525. do	Crispulo Zamora, 351 San Sebastian, Manila.
3526. do	J. A. Murphy, Iligan, Mindanao.
3527. do	Felipe Agoncillo, 815 Wright, Manila.
3528. do	Florencio Gonzales Diez, 324 Alix, Manila.
3529. do	Serafin Gatuslao, Himamaylan, Occidental Negros.
3530. do	José Yulo Jong Chipco Jocban, Iloilo, Iloilo.
3531. do	Serafin Novella, Saravia, Occidental Negros.
3532. do	Candido Montilla, Bacolod, Occidental Negros.
3533. do	Teofilo Pedro, Malabon, Rizal.
3534. do	Eusebio Orense, Bauang, Batangas.
3535. do	Leandro Gruet, 59 P. del Carmen, Manila.
3536. do	C. D. Aguilar, Moncada, Tarlac.
3537. do	Roger S. Fitch, Fort McKinley, Rizal.
3538. do	Esperanza Villadelgado, Iloilo, Iloilo.
3539. do	José Reguera, Iloilo, Iloilo.
3540. do	Manuel Borja, Malabon, Rizal.
3541. do	Chris J. Holland, Lucena, Tayabas.
3542. do	J. H. Neff, Camp John Hay, Baguio, Benguet.
3543. do	Elliott Holloway, 35 Ignacio, Pasay, Rizal.
3544. do	Alfredo Roench, 262 Gral. Luna, Manila.
3545. do	Hugo Roseburg, 3 Brixton Hill Ave., Manila.
3546. do	Tirso Irureta Goyena, 815 Wright, Manila.
3547. do	Bureau of Education, Cabanatuan, Nueva Ecija.
3548. do	Valentin Racela, Lucena, Tayabas.
3549. do	Antonio de Quesada, San Juan del Monte, Manila.
3550. do	Leyte Land Transportation Co., Manila.
3551. do	Victoria Tuason, 588 Alix, Manila.
3552. do	Juvencio C. Trinidad, Lucena, Tayabas.
3553. do	F. N. Chilton, Camp John Hay, Baguio.
3554. do	Lorenzo Ferez, 638 Reina Regente, Manila.
3555. do	Dalmacio Olegario, 2141 Herran, Manila.
3556. do	A. M. Reith, Bankhouse, Uli-Uli, Manila.
3557. do	Lieut. Eacot B. Miller, P. S., Baguio.
3558. do	Daniel Martinez, La Paz, Tarlac.
3559. do	Antero Montenola, La Carlota, Occidental Negros.
3560. do	Diosdado Sanciano, Cabanatuan, Nueva Ecija.
3561. do	Matie Maynord Hensley, Fort McKinley, Rizal.
3562. do	Clarence O. Sherrill, 1272 M. H. del Pilar, Manila.
3563. do	Enrique Alvarez, Atimonan, Tayabas.
3564. do	Angel Vargas, Iloilo, Iloilo.
3565. do	Celedonio Baylon, 2147 Azcarraga, Manila.
3566. do	Philippine Sugar Development Co., Calamba, Laguna.
3567. do	Do.
3568. do	Francisco Campopos, Ligao, Albay.
3569. do	John Ohaus, 234 Gral. Solano, Manila.
3570. do	Charles W. McClure, Eighth U. S. Infantry, Manila.
3571. do	Pedro Golingco, Tabaco, Albay.
3572. do	Vicente Fernandez, 739 Magdalena, Manila.
3573. do	Marcos Garcia, Biñan, Laguna.
3574. Automobile	Doroteo Aguilar, Atimonan, Tayabas.
3575. do	M. M. de Barretto, 1582 Pennsylvania, Manila.
3576. do	J. M. Liddell, 102 Gral. Solano, Manila.
3577. do	Major S. A. Cloman, Fort McKinley, Rizal.
3578. do	J. A. Murphy, Iligan, Mindanao.
3579. do	Sultan of Sulu, Jolo, Mindanao.
3580. do	Lieut. Guy W. McClelland, Fort McKinley, Rizal.
3581. do	W. H. Lawrence, Pasay, Rizal.
3582. do	Marcelo Cariñgal, 667 Benavides, Manila.
3583. do	Dr. W. E. Musgrave, c/o Philippine General Hospital, Manila.
3584. do	Bureau of Forestry, Manila.
3585. do	José Jimenez, 982 Singalong, Manila.
3586. do	Rafael Pabalan, Calamba, Laguna.
3587. do	Asuncion Michel, 973 Azcarraga, Manila.
3588. do	Vicente Noble, Taal, Batangas.
3589. do	Antonio Po-Dico, Calamba, Laguna.
3590. do	Richard H. Gibbs, Jolo, Mindanao.
3591. do	Quartermaster Corps, Manila.
3592. do	M. E. Martin, Bayambang, Pangasinan.
3593. do	J. F. Yunti y Almeda, San José, Biñang, Laguna.
3594. do	Montague Lord, Cebu, Cebu.
3595. do	Shannon Richmond, Legaspi, Albay.
3596. do	J. Carrero, 504 Martinez, Manila.
3597. do	Dr. Luis R. Guerrero, 148 Isaac Peral, Manila.
3598. do	Quartermaster Corps, Camp Overton, Zamboanga.
3599. do	Roy J. Berry, 223 Gral. Luna, Manila.
3600. do	Manila-Baguio Automobile Line, Manila.
3601. do	Justo Cuaycong, Saravia, Occidental Negros.
3602. do	Philippine Sugar Development Co., Calamba.
3603. do	Do.
3604. do	Do.
3605. do	Province of Ilocos Sur.
3606. do	R. R. Landon, Calle Santo Niño, Iloilo.
3607. do	Manuel Coromina, 2148 Azcarraga, Manila.
3608. do	Luis McCall, Elks Club, Manila.
3609. do	Wagner Transportation Co., Baguio.
3610. do	D. L. Hazeltine, care of Estrella Auto Palace, Manila.
3611. do	Baldomera Garcia, Guinobatan, Albay.
3612. do	Horace L. Higgns, Caloocan, Rizal.
3613. do	The Tayabas Land Co., 386 Gral. Luna, Manila.
3614. do	Manuel Abello, Isabela, Occidental Negros.
3615. do	Nicolas Borromeo, Silay, Occidental Negros.
3616. do	Felipe M. Tionko, Silay, Occidental Negros.
3617. do	Yu Bao Sontua, 209 Dasmariñas, Manila.
3618. do	Nicanor Jacinto, 232 Alix, Manila.
3619. do	Manuel Locsin, Pontevedra, Occidental Negros.
3620. do	Appelbee-Neuman Manufacturing Co., 828 Misericordia, Manila.
3621. do	Alfredo Olbez, Albay, Albay.
3622. do	Liberato Garcia, Cabanatuan, Nueva Ecija.
3623. do	Enrique Alvarez, Atimonan, Tayabas.
3624. do	Eulalio Antillo, 410 Peñalosa, Manila.
3625. do	E. A. Peacock, 150 Buenavista, Manila.
3626. do	Thomas Hankins, 634 Sales, Manila.
3627. do	Eagle Transportation Co. Davao, Mindanao.
3628. do	Enrique Magalona, Saravia, Occidental Negros.
3629. do	Mills Dean, 940 M. H. del Pilar, Manila.
3630. do	Martin de los Reyes, 1301 Misericordia, Manila.
3631. do	Gabriela Mendoza, 19 Andante, Malabon, Rizal.
3632. do	Luis P. Torres, 1712 Azcarraga, Manila.
3633. do	Capt. R. H. Allen, Fort Wm. McKinley, Rizal.
3634. do	Bruce Palmer, Fort Wm. McKinley, Rizal.
3635. do	John Bordman, Calle Ortiz, Iloilo.
3636. do	Chester R. Haig, Fort Wm. McKinley, Rizal.
3637. do	Antonio Soriano, Cabanatuan, Nueva Ecija.
3638. do	Guevara & Alonso, Goa, Ambos Camarines.
3639. do	P. H. Frank, Zamboanga, Mindanao.
3640. do	Leopoldo Mijares, Bacolod, Occidental Negros.
3641. do	City of Manila.
3642. do	Quayle's Second Hand Store, 328 Echague, Manila.
3643. do	Perico Villafranca, Daet, Ambos Camarines.
3644. do	P. H. Frank, Zamboanga, Mindanao.
3645. do	William H. Peek, 1272 M. H. del Pilar, Manila.
3646. do	Mariano Uy Chaco Sons & Co., Manila.
3647. do	Luis R. Yangco, 628 Herran, Manila.
3648. do	Province of Nueva Ecija.
3649. do	Agustina Santos de Arevalo, 720 Misericordia.
3650. do	Bureau of Public Works, Manila.
3651. do	Dr. Galicano Apacible, 506 Misericordia, Manila.
3652. do	Alfredo Pardo de Tavera, 537 Raon, Manila.
3653. do	Francisco Blanco, Cebu, Cebu.
3654. do	Valentin Racela, Lucena, Tayabas.
3655. do	Perfecto Jacinto, 960 Juan Luna, Manila.
3656. do	José Francisco y Tecson, 401 Elcano, Manila.
3657. do	Hacienda de Calauang, Calauang, Laguna.
3658. do	Tito Silverio, Pontevedra, Occidental Negros.
3659. do	Province of Lanao, Mindanao.
3660. do	George Robinson, Cuartel de España, Manila.
3661. do	F. S. Douglass, 999 Pasay Road, Rizal.
3662. do	Ramon Aboitis, Juan Luna, Cebu, Cebu.
3663. do	E. H. Teal, 20 Divisoria, Manila.
3664. do	Tomas Sy Quia, Vigan, Ilocos Sur.
3665. do	Rafael S. Villanueva, 564 Merced, Manila.
3666. do	Antonio Campos Rueda, 115 San Marcelino, Manila.
3667. do	L. Wadsworth, Camp Stotsenburg, Pampanga.
3668. do	José Gaston, Silay, Occidental Negros.
3669. do	Sabas, Locsin, Molo, Iloilo.
3670. do	Emiliano Lizares, Talisay, Occidental Negros.
3671. do	Luis Rotea, Tanjay, Oriental Negros.
3672. do	Lorenzo Zayco, Cabancalan, Occidental Negros.
3673. do	Roque Sanson, Molo, Iloilo.
3674. do	Enrique Echaus, Hinigaran, Occidental Negros.

Automobiles Registered in the Automobile Division, Bureau of Public Works, from January 1 to June 30, 1915—Continued.

Registry No. and type.	Owner's name and address.
3675. Automobile	Richard Toovey, care of Stevenson & Co., Manila.
3676. do	Urrutia & Co., 1057 M. de Industria.
3677. do	C. J. Heffting, Heffting House, Manila.
3678. do	Benito & Moll, Tigaon, Ambos Camarines.
3679. do	Domingo Ciocon, Talisay, Occidental Negros.
3680. do	Marciano Araneta Yulo, Bago, Occidental Negros.
3681. do	Felix Montinola y Lozado, Saravia, Occidental Negros.
3682. do	John Gibson, Manila Hotel, Manila.
3683. do	Trinidad Arcinas, 365 Gral. Luna, Manila.
3684. do	E. G. Clark, Cabanatuan, Nueva Ecija.
3685. do	Philippine Assembly, Manila.
3686. do	Dr. H. L. Freeland, Camp Nichols, Rizal.
3687. do	Capt. H. M. Bankhead, Fort McKinley, Rizal.
3688. do	Lieut. R. C. Taylor, Fort McKinley, Rizaal.
3689. do	Lieut. M. A. Elser, Fort McKinley, Rizal.
3690. do	Fernando Codes, La Carlota, Occidental Negros.
3691. do	Ko Suanco, Victorias, Occidental Negros.
3692. do	Julio F. Neri, Mambajao, Misamis.
3693. do	Francisco Garin, Atimonan, Tayabas.
3694. do	Frances Heterick, 913 Indiana, Manila.
3695. do	Robert K. Netherland, Bayambang, Pangasinan.
3696. do	Fred Fisher, Hausserman, Cohn & Fisher, Manila.
3697. do	Bureau of Health, Manila.
3698. do	Lorenzo Perez, 638 Regina Regente, Manila.
3699. do	Modesto Ledesma, Jaro, Iloilo.
3700. do	Carolyn D. Dillon, Fort McKinley, Rizal.
3701. do	Ricardo Gurrea, 145 M. de Comillas, Manila.
3702. do	Gavino Limkaco, Guinobatan, Albay.
3703. do	Ramon J. Fernandez, 3 San Rafael, Manila.
3704. do	C. H. McClure, Dagupan, Pangasinan.
3705. do	W. Keller, care of Keller & Co., Ltd., Manila.
3706. do	Lieut. R. E. Jones, Camp McGrath, Batangas.
3707. do	Chas. S. Derham, 1332 Pennsylvania Ave., Manila.
3708. do	Capt. P. Brown, Fort McKinley, Rizal Province.
3709. do	José de Guzman, 722 Santo Cristo, Manila.
3710. do	Adelayda Hollman, 19 Mabini, Manila.
3711. do	Marcelo Segovia, Manduriao, Jaro, Iloilo.
3712. do	Joseph Miller, Iloilo, Iloilo.
3713. do	Carlos Dizon, 508 Salcedo, Manila.
3714. do	Feliciano Quiogue, 247 Soler, Manila.
3715. do	E. A. Dean, 151 Gral. Luna, Manila.
3716. do	Lim Tuico, 200 Rosario, Manila.
3717. do	Adela V. de Pabalan, Calamba, Laguna.
3718. do	Madaya Milling Co., Dansalan, Lanao Province.
3719. do	Juana Pamposo, Iligan, Misamis.
3720. do	Rafael Monserrat, Lingayen, Pangasinan.
3721. do	B. Rahmeyer, 54 San Luis, Manila.
3722. do	J. R. Wilson, care of Kneedler Building, Manila.
3723. do	Julian Locsin, Daraga, Albay.
3724. do	J. M. Liddell, 102 Gral. Solano, Manila.
3725. do	The Benguet Commercial Co., Ltd., Baguio.
3726. do	Nieves C. de Jordan, 389 R. Hidalgo, Manila.
3727. do	Vela Hermanos, Naga, Ambos Camarines.
3728. do	Chua Guioc, 568 Azcarraga, Manila.
3729. do	Basilia Dairit Vda. de Herrera, 720 Colorado.
3730. do	José Ma. Borromeo, Cebu, Cebu.
3731. do	Maria Tereza Garage, Vigan, Ilocos Sur.
3732. do	Bureau of Education, Manila.
3733. do	Enrique de la Vega, 746 Union, Manila.
3734. do	J. B. Reid, 10 San Gabriel, Manila.
3735. do	Francisco Sanchez, Bacolod, Occidental Negros.
3736. do	Madaya Milling Co., Dansalan, Lanao Province.
3737. do	Oquiñena, Y Ca., Ltd., Cebu, Cebu.
3738. do	Charles L. Hendell, Manila, Curio Central, Manila.
3739. do	Martin de los Reyes, 1301 Misericordia, Manila.
3740. do	Manuel Tuason, Gral. Luna, Manila.
3741. do	Pedro Madrigal, Boac, Marinduque, Tayabas.
3742. do	M. Roses, 127 Aviles, Manila.
3743. do	Consolación Singian, 1250 M. H. del Pilar.
3744. do	Felipe Buencamino, jr., 2229 Azcarraga, Manila.
3745. do	Ricardo Gonzaga, Victorias, Occidental Negros.
3746. do	Lievt. Col. C. B. Morse, Thirteenth Infantry, Batangas.
3747. do	Carolyn D. Dillong, Fort McKinley, Rizal.
3748. do	Maj. J. D. Long, Director of Health, Manila.
3749. do	San Miguel Brewery Factory, Aviles, Manila.
3750. do	Bureau of Public Works, Manila.
3751. do	Walter J. Grodske, jr., care of Bureau of Public Works, Manila.
3752. do	H. C. Liebenow, care of Philippine Vegetable Oil Co., Manila
3753. do	G. W. Cochen, Fort Mills, Corregidor Island.
3754. do	James F. Macleod, 955 Santa Mesa, Manila.
3755. do	Felipe Jacinto, 634 P. Herrera, Manila.
3756. do	Mrs. F. C. Laing, 584 Peñafrancia, Manila.
3757. do	Province of La Union, San Fernando Union.
3758. do	Julian D. Yap Tionqui, 429 Aviles, Manila.
3759. do	Jno. T. Pickett, 150 Valenzuela, Manila.
3760. do	J. J. Edwards, 612 Union, Manila.
3761. do	Otto Vorster, Singalong, Manila.
3762. do	Julio Llorente, Lingayen, Pangasinan.
3763. do	Felix Velasco, Silañg, Cavite.
3764. do	Alfred Withworth Allen, Iloilo, Iloilo.
3765. do	Rueda Hermanos, 25 Plaza Moraga, Manila.
3766. do	Co Kuan, 542 Echague, Manila.
3767. do	Marcos Suarez, Bacolod, Occidental Negros.
3768. do	Graciano M. de la Rama, Bacolod, Occidental Negros.
3769. do	Hijos de I. de la Rama, Iloilo, Iloilo.
3770. do	Do.
3771. do	Do.
3772. do	José Trinidad, 834 Rizal Ave., Manila.
3773. do	Dr. Victor Sevilla, 21 Legaspi, Manila.
3774. do	P. J. Moore, Zamboanga, Mindanao.
3775. do	Do.
3776. do	P. H. Frank, Zamboanga, Mindanao.
3777. do	Wagner Transportation Co., Baguio, Benguet.
3778. do	Carlos Dizon, 508 Salcedo, Manila.
3779. do	Ng. Yuen, 63 Echague, Manila.
3780. do	Felix Morales, Lucena, Tayabas.
3781. do	Nacional Filipina Co., Tinajeros, Malabon-Rizal.
3782. do	Fernando Zobel, 165 M. de Comillas, Manila.
3783. do	Romana Ascue, 410 Peñarubia, Manila.
3784. do	Otto Ranft, care of Germann & Co., Manila.
3785. do	
3786. Automobile	Antonio M. Heras Lim-Hing, 127 Plaza del Conde.
3787. do	Province of Pangasinan.
3788. do	Ramon F. Alberto, 924 Santol, Manila.
3789. do	A. F. Nadler, 814 Indiana, Manila.
3790. do	Oleaga & Co., Aparri, Cagayan.
3791. do	Hugo Roseburg, 3 Brixton Hill Ave., Manila.
3792. do	Simon Mendoza, 845 Jaboneros, Manila.
3793. do	A. M. Barretto, Spanish Consul, Manila.
3794. do	J. M. Liddell, 102 Gral. Solano, Manila.
3795. do	N. W. Gilbert, Uy Chaco Building, Manila.
3796. do	Alfredo L. Guerrero, 117 A. Mabini, Manila.
3797. do	D. Fletcher, 209 Gral. Solano, Manila.
3798. do	José Arriola, 617 Gral. Luna, Manila.
3799. do	H. E. Stafford, 124 Gral. Solano, Manila.
3800. do	W. E. Lind, care of American Hardware Co., Manila.
3801. do	M. P. Leuterio, 667 Rizal Ave., Manila.
3802. do	Felix Barot, Tanjay, Oriental Negros.
3803. do	Standard Oil Co., Manila.
3804. do	Bureau of Education, Manila.
3805. do	John Gordon, 124 Lamasana, Quiapo, Manila.
3806. do	Ricardo Barretto y Gorostia, 231 Gral. Solano, Manila.
3807. do	Gervacio Morelos, 2303 Rizal Ave., Manila.
3808. do	Fidel de Ocampo, Lucena, Tayabas.
3809. do	Antonio Brias y Roxas, 624 Pennsylvania Ave., Manila.
3810. do	Ubaldo Enriquez, Samboang, Cebu.
3811. do	Alfonso Sy Cip, 239 Gral. Solano, Manila.
3812. do	Matilde Rodriguez de Ferrer, Cebu, Cebu.
3813. do	Anastacio N. del Corro, Carcar, Cebu.
3814. do	Bureau of Lands, Manila.
3815. do	Carlos Tarrosa, Sarafia, Occ. Negros.
3816. do	Luciano Bernabe, 708 Salcedo, Manila.
3817. do	James Ross, Roxas Building, Manila.
3818. do	Francisco Bastida, Tejeron, Manila.
3819. do	Maria Villanueva de Salas, 489 Peñafrancia, Manila.
3820. do	Wm. F. Daland, 771 Echague, Manila.
3821. do	Luis Ramirez de Arellano, 102 Estero de Binondo.
3822. do	J. C. Graham, Los Baños, Laguna.
3823. do	J. J. Russell, 7 Nagtajan, Manila.
3824. do	Hon. Florentino Torres, 1712 Azcarraga, Manila.
3825. do	Bureau of Agriculture, Manila.
3826. do	Mercedes Villanueva de Hilario, 174 Real, Walled City.
3827. do	Lieut.Col. A. W. Yates, Fort Santiago, Manila.
3828. do	W. J. B. Burke, 48 Aviles, Manila.
3829. do	Capt. C. F. Humphrey, jr., U. S. Army, Twenty-fourth Infantry, Manila
3830. do	George E. Ball, Fort McKinley, Rizal.
3831. do	Tomas R. Sy Quia, Vigan, Ilocos Sur.
3832. do	Guillermo Lopez, Naga, Ambos Camarines.
3833. do	Agaton Araneta, San Marcos, Molo, Iloilo.
3834. do	Isidoro Escares, Saravia, Occidental Negros.
3835. do	Emilio Parroco, Pontevedra, Occidental Negros.
3836. do	Wm. H. Cox, jr., A. E., Y. M. C. A., Manila.
3837. do	Pietro Caronna, 1258 M. H. del Pilar, Manila.
3838. do	Bureau of Education, Cebu, Cebu.
3839. do	Silver Dollar Plaza Garage, Manila.
3840. do	Leonardo Osorio, 43 Aviles, Manila.
3841. do	A. de Guzman Floriendo, Binalonan, Pangasinan.
3842. do	Florentino Pamintuan, 900 M. H. del Pilar, Manila.
3843. do	Ricardo A. Reyes, 305 Misericordia, Manila.
3844. do	Roy H. Brown, Albay, Albay.
3845. do	Leyte Land Transportation Co., Tacloban.
3846. do	Do.
3847. do	Tom D. Gunn, Imperial Hotel, Manila.
3848. do	W. I. Wood, 755 Soler, Manila.
3849. do	Catalino Rodriguez, Sariaya, Tayabas.
3850. do	Estrella del Norte, Manila.
3851. do	Roy J. Berry, 223 Gral. Luna, Manila.
3852. do	J. F. Fernandez, 275 Concepcion, Manila.
3853. do	W. L. Foard, care of Manila Hotel, Manila.
3854. do	Carlos Cuyugan, 392 Lamayan, Manila.
3855. do	Philippine General Hospital, Manila.
3856. do	Oscar Schuze, 1259 Pennsilvania Ave., Manila.
3857. do	Pedro Gil, 147 A. Mabini, Manila.
3858. do	Antonio Melian, 174 M. de Comillas, Manila.
3859. do	Charles L. Maxfield, Bacolod, Occidental Negros.
3860. do	Antonio Monfort, Cadiz, Occidental Negros.
3861. do	Ruperto Montinola, Iloilo, Iloilo.
3862. do	P. H. Frank, Zamboanga, Mindanao.
3863. do	C. E. Casey, Albay, Albay.
3864. do	Santiago Elizalde, 600 L. Guerrero, Manila.
3865. do	Andres Borromeo, Cebu, Cebu.
3866. do	Marcel Blum, care of Manila Hotel, Manila.
3867 do	Mariano Veloso, Cebu, Cebu.
3868. do	Estefanea Veloso, Cebu, Cebu.
3869. do	Bureau of Lands, Manila.
3870. do	Sy Ling Ching, 752 Tabora, Manila.
3871. do	Thomas Sunico, 904 Wright, Malate, Manila.
3872. do	V. D. Garcia, 842 Santa Mesa, Manila.
3873. do	José Y. de Jesus, 900 Folgueras, Manila.
3874. do	Hon. Jaime C. de Veyra, Manila.
4000. Motorcycle	Province of Zamboanga, Department of Mindanao and Sulu.
4001. do	Bureau of Education, Manila.
4002. do	H. A. Kohlmeyer, navy yard, Cavite.
4003 do	A. B. Talmage, Bacolor, Pampanga.
4004. do	L. Z. Burgess, Lingayen, Pangasinan.
4005. do	J. Villanueva, Pasig, Rizal.
4006 do	Bureau of Agriculture, Manila.
4007. do	J. G. Falkenrath, Y. M. C. A., Manila.
4008. do	O. C. Kemp, Tagudin, Mountain Province.
4009. do	Mariano Ramos, Quiñgua, Bulacan.
4010. do	O. Porter, Mexico, Pampanga.
4011. do	Bureau of Agriculture, Manila.
4012. do	James F. Lawrence, Laoag, Ilocos Norte.
4013. do	Bureau of Posts, Manila.
4014. do	Do.
4015. do	Emilio Corteza, Bago Occ. Negros.
4016. do	Celso Lobregat, 312 Gral. Luna, Manila.
4017. Tricycle	H. F. Streegan, 154 Novaliches, Manila.
4018. Motorcycle	Joseph L. Parrott, Argao, Cebu.

APPENDIX C.

PROJECTS ACTIVE APRIL 1, 1915.

Provinces.	Roads and trails.				Bridges and culverts.				Provincial administration buildings.			Municipal administration buildings.			Prisons.			Schools.				Construction and operation.										Total.
	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair and alteration.	Construction.	Reconstruction.	Maintenance.	Construction.	Repair and alteration.	Maintenance.	Construction.	Maintenance.	Repair and alteration.	Reconstruction.	Markets.	Parks, grounds, and athletic fields.	Miscellaneous buildings.	Ferries.	Water systems.	Record vaults.	Quarries.	Telephone lines.	Electric-light plants.	Miscellaneous.	
Albay	2	1			1					1		1						4				2		1							1	14
Ambos Camarines	3	8		1	2	1							1					1				3										20
Antique	3	2			1													1														7
Bataan	3	3		2			1																								2	11
Batangas	2	3			1	1					1	1				1		4			1	2	1	1		1					1	21
Bohol	3	3			4																					1					1	12
Bulacan	1	4				1												3				2									4	15
Cagayan	2	2			2							1				1		1							1						8	18
Capiz	3	3	2		7													2					1	1	1							20
Cavite	5	2			1													2														10
Cebu	6	2	1															1						2		1					1	14
Ilocos Norte	2	2			1													5			1	2										13
Ilocos Sur	11	3	1		3	1							1	1				5				3		1	2	1					5	38
Iloilo	5	3	1		1		2					1						3				1				1					4	22
Isabela	3	2			1	1												1						1								9
Laguna	3	3	4		3			1										14	1	1						1		1	1		3	36
La Union	4	3			2				1									7				2	1		1							21
Leyte	1	2	1		9													3				2										18
Misamis	4	3			2													1														10
Nueva Ecija	3	2			1													4				3	1									14
Occidental Negros	11	2			5													2				2		1	1						1	25
Oriental Negros	5	4			2					1								3				3				1			1		1	21
Pampanga	4	2														1		4					1									12
Pangasinan	5	3	3		3							2	1					3		1		5			1						1	28
Rizal	1	8	1		2					1							1	3				1		3					1			22
Samar	5	2			1													2	1			1	1		1						2	16
Sorsogon	3	7			1				1									2					1	1							7	23
Surigao	2	2																4		3												11
Tarlac	1	3			1				1									1				1									1	9
Tayabas	3	4			1													2				5		1								16
Zambales		3			10																				1	1					2	17
Total	109	96	14	3	68	5	3	1	3	3	1	6	3	1		3	1	88	2	5	2	40	7	13	9	8		1	3		45	543

NOTE.—The 45 projects under the caption "Miscellaneous" represent 5 surveys and investigations of roads, bridges, water systems, etc., 2 wharves, 2 harbor maintenance, 2 dikes, 2 river controls, 1 irrigation system, 1 auto line, etc.

BUREAU OF PUBLIC WORKS

ORGANIZATION

WARWICK GREENE, *Director of Public Works*
C. E. GORDON, *Acting Director of Public Works*
G. C. FENHAGEN, *Consulting Architect*
G. G. STROEBE, *Acting Chief Designing Engineer*
H. F. CAMERON, *Senior Supervising Engineer, Mindanao and Sulu*

C. LINDSEY, *Assistant to the Director*
WILLIAM HIRZEL, *Chief Accountant*
O. K. OLESON, *Property Clerk*

L. L. COOK, *Superintendent of Automobiles*
JOSE VENTANILLA, *Record Clerk*

CONSTRUCTING DIVISION

E. J. WESTERHOUSE (Absent), *Chief Constructing Engineer*
D. E. HENRY, *Senior Supervising Engineer*
J. W. VICKERS, *Superintendent of Artesian Wells*

DISTRICT ENGINEERS

Brown, E. C.	Albay, Albay
Dandois, Chas. S.	Naga, Ambos Camarines
Segura, Valeriano	San Jose, Antique
Williams, A. D.	Baguio, Benguet
Francisco, Luis	Balanga, Bataan
Marshall, J. T.	Batangas, Batangas
Harrison, J. L.	Malolos, Bulacan
Boggess, L. S.	Tagbilaran, Bohol
Barry, R. L.	Tuguegarao, Cagayan
Bennett, C. R.	Cavite, Cavite
Sjovall, A. H.	Capiz, Capiz
Russell, Claud	Cebu, Cebu
Klise, R. D.	Cotabato, Cotabato
Tayzon, Antonio	Davao, Davao
Glenn, R. V.	Iloilo, Iloilo
Baluyot, Sotero	Laoag, Ilocos Norte
Smith, E. D.	Vigan, Ilocos Sur
Gomez, Pastor	Ilagan, Isabela
Kasilag, Marcial	San Fernando, La Union
Barry, J. R.	Los Baños, Laguna
Clark, L. T.	Tacloban, Leyte
Meehleib, H. R.	Dansalan, Lanao
Caton, J. H. 3rd	Manila
Scheidemantel, L. W.	Cagayan, Misamis
Honska, W. B.	Calapan, Mindoro
Austin, A. W.	Cabanatuan, Nueva Ecija
Palmer, W. C. A.	Bacolod, Occidental Negros
Grosvenor, I. R.	Dumaguete, Oriental Negros
Halsema, E. J.	San Fernando, Pampanga
Morrison, C. G.	Lingayen, Pangasinan
Brown, L. R.	Pasig, Rizal
Baugh, N. R.	Catbalogan, Samar
Lilley, H. B.	Sorsogon, Sorsogon
Ines, Leon	Surigao, Surigao
Schenk, E. E.	Jolo, Sulu
Agcaoili, Romarico	Tarlac, Tarlac
Sylvester, A. T.	Lucena, Tayabas
Vallarta, Julian	Iba, Zambales
Cookingham, J. C.	Zamboanga, Zamboanga